No dust

summer

quarterly publication of

CURATOR

the american museum of natural history

Volume I Number 3 Summer, 1958

CURATOR

A Quarterly Publication of The American Museum of Natural History

CURATOR

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CURATOR is published quarterly by The American Museum of Natural History, Central Park West at 79th Street, New York 24, New York. It is a journal of opinion, and the views expressed in its articles are not necessarily those of the Museum.

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On First Looking Into Chapman's New Forest

DEAN AMADON, LAMONT CURATOR OF BIRDS
THE AMERICAN MUSEUM OF NATURAL HISTORY

The museum habitat group re-creates a slice of the outdoors, a segment of the landscape with fauna and flora intact. At The American Museum of Natural History, the pioneer in this method of museum exhibition was the late Frank M. Chapman (1864–1945). The Museum's Hall of North American Birds, opened about fifty years ago, was, for a project of such magnitude, to a remarkable degree the work of this one man. Chapman traveled the length and breadth of the continent to gather the materials[1]; he photographed the locales, and sometimes took with him L. A. Fuertes or the other artists who were to paint the backgrounds; finally, he supervised every detail of the construction. In his autobiography, Chapman told of his jubilation when Morris K. Jesup, then President of the Museum, inspected the first habitat group in the Museum and expressed enthusiastic approval.[2]

In the years that have passed, the habitat group has become a fixture in all museums of natural history large enough to afford them. The American Museum of Natural History was one of the first to use such groups, and has produced them on a larger scale than has any other institution. Our halls of African and North American Mammals and of Oceanic Birds are unrivaled in scope and seldom matched in perfection of detail elsewhere.

Impressive though they may be, habitat groups are not without their

[1] See his "Camps and Cruises of an Ornithologist," D. Appleton and Company, 1908.
[2] "Autobiography of a Bird-Lover," D. Appleton-Century Company, 1933.

Chapman's group of birds in England's New Forest.

detractors. The sportsman, the conservationist, the "man in the street," favor the panorama; the specialist, the scientist, and the teacher (if not his pupils), often prefer smaller, more explicit exhibits which illustrate a particular fact about some aspect of natural history. Concerning the value of the latter type of exhibit there can be no question. They have existed as long as there have been museums and will continue to do so.

It is the habitat group that requires defense. There are those who believe that museums are going to a great deal of bother and expense to create panoramas which may amuse or delight the public eye, but which possess little intrinsic worth. One might point out that the objects in a museum of fine arts have no obvious lesson to teach, either. The support of large public museums is dependent to some extent upon the throngs who visit them. These throngs will not come to an institution designed

purely as an adjunct of the classroom or laboratory. But the habitat group can be far more than a means of mass entertainment.

A recent critic[3] of habitat exhibits states that it is now known that specific "one-idea" exhibits convey more to the viewer than those giving a general impression. Who, one wonders, found this out? Possibly they were educators, who proved it by testing the subjects with small, specific questions. At any rate, looking back twenty-five years to my courses in college, or fifteen years to Army basic training, I remember few specific details, but do retain a few general impressions, some of them, I hope, not entirely useless.

Indeed, I suspect that too much of the specific is as bad as or worse than too many generalities. A friend of mine had the privilege, while at Harvard, of taking Professor Kittredge's famous course in Shakespeare. My envy decreased somewhat when I found that he never reads poetry now, and that of the course itself he recalls, apparently, only the Professor's disquisition on the etymology of "codpiece."

It may be, then, that in museum exhibits, as on Madison Avenue, we should at times try to present the "big picture," as well as the bits of which it is composed—to see the forest as well as the trees. Chapman's group of the birds of England's New Forest—the particular butt of Mr. Hellmann's strictures—is admittedly not a triumph of the habitat technique. As Melville said, it is possible to write an epic about a whale, but not about a mouse—nor, one might add, a titmouse. I don't know why Chapman put so *many* little birds in this group. But they are not particularly intrusive, and one does get some feeling of the cherished English forest and its immemorial beeches. It is this aspect of conservation, of getting across to the public the beauty, complexity, and unity of unspoiled nature—the need for its preservation, not in museums, but in life—which can become a much greater part of the value and appeal of the habitat group.

To revert to the paraphrase of Keats used as a title, I believe that in a hall of oceanography one should have, in addition to exhibits about the ocean's salinity, depth, age, and temperature, a panorama that will help us to share the exhilaration of Cortez, when

> ". . . with eagle eyes
> He stared at the Pacific—and all his men
> Looked at each other with a wild surmise—
> Silent, upon a peak in Darien."

[3] Hellmann, R., *Curator*, 1958, Vol. I, No. 1, pp. 74–76.

PHOTOGRAPH BY THE AMERICAN MUSEUM OF NATURAL HISTORY

Field-Work in Relation to Museum Classroom Teaching

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In order that a museum department be successful in any capacity it is essential that the personnel involved be vitally interested in the particular fields of their endeavors.

This statement, when applied to a scientific department which undertakes research as one of its major functions, is indisputable. A modicum of thought will lead to the conclusion that it applies equally well to any other department of a museum. Yet it is an unfortunate fact that this is not always realized, either by administrative bodies or by the personnel themselves. The objects of this paper, then, are to attempt, first, to stress personnel interest, and second, by using my personal observations and experiences as a field of reference, to present a few thoughts on the value of field-work as a means of building up, cementing, and maintaining an interest in one's work.

Because my practical experience has been mostly in teaching in the Department of Public Instruction at The American Museum of Natural History, where the lectures basically deal with subject-matter either in natural science or in anthropology, the reader must excuse a definite bias in that direction; but it seems evident that the fundamental ideas set forth in this paper could be modified to fit a similar department in any other type of museum.

It would seem that, by reason of the fairly specialized nature of his topics, and the wide disparity in both age and background with which he is constantly faced in lecturing to different groups, the museum instructor needs to have a genuine enthusiasm for teaching, and fully as genuine an interest in his subject. The latter most certainly calls for a

continuance of interest outside museum working hours; yet, unfortunately, there are some instructors whose interest ends with the departure of their classes. Their lectures consist of "book-learned" material, or a conglomeration of facts and ideas derived from watching other teachers at work. Usually, with little or no personal experience from which to draw, these lectures fall far short of success. The listeners—children as well as adults—are quick to see that the teacher is not well-versed in his subject; their interest flags, and the instructor finds his job becoming dull, routine, and unrewarding to either his audience or himself.

Conversely, the teacher with a specialized interest could conceivably mirror it in diametrically opposite ways. He could become extremely narrow-minded, a state of affairs which is definitely not to be encouraged in anybody involved in teaching. He could—and this is more serious—develop an inflated ego. This means that, in believing himself to be an expert, he would become condescending, impatient and pedantic, especially with beginners in the field. In either case, bad student-teacher relationships would result, ending the usefulness of the instructor.

Of course, the majority of museum instructors are happy to give up much of their own time to their fields of study, and few of them become fanatics, or unbearably pretentious. Their lectures, in contrast to the uninspired variety to which reference has already been made, are effortless in delivery, and rich in content. Both the teacher and his audience are left with the feeling that the experience has been well worth-while.

Wherever possible, then, an instructor's enthusiasm should be fostered by the museum department employing him. In a museum of natural history this might well be done by providing opportunities for field-work, which, for the purposes of this paper, will be defined as consisting of any one of three categories.

II

The first of these categories consists of what may be termed the "Busman's Holiday," on which the instructor visits other museums and institutions connected with his field of interest. No single institution, no matter how large or diversified, can possibly include everything, whether it be in the actual material available, the presentation of this material to the general public, or the type of educational programs to be found. A mere day spent in visiting a "sister-institution"—for one should not think in terms of rivalry where education is concerned—and in talking to staff-members, invariably produces much food for thought in regard to teaching techniques or additional information on a variety of subjects. The value of such visits is obvious.

The second category might be called "Social Field-work." In the case

of a businessman, this might include cocktails with business associates, when ideas and information could be exchanged. When applied to museum instructors—or, indeed, to most museum personnel—it refers to get-togethers with other people having the same fields of interest—possibly with the cocktails still in evidence. In this case, however, it includes both professional and amateur associates, for since museum work deals with subjects in which the layman is interested, experts are to be found in his ranks as well as among professionals. Conversations with these people, and attendance at lectures, conferences, and other group-meetings for the purpose of discussing questions and problems connected with one's profession, are valuable means of increasing knowledge and efficiency.

Third, and, when applied to a museum of natural history, possibly the most important of all, is the category of field-work which may be headed "Field Study." This involves the instructor's getting out and personally investigating his subject. To my mind, it is by far the most enjoyable and rewarding form of field-work, bringing a tremendous sense of personal satisfaction, and an increase in knowledge to a greater degree than is possible by any other method. The information gleaned by personal observation and investigation is information which sticks. The experiences which form part of the process of getting this information become invaluable in passing on knowledge to others. The discovery of an uncommon species of plant or animal, or of some fact connected with it which is not generally known; the experience of watching an Indian weaver at work; the finding of a fossil fern, or brachiopod; all of these things make a far greater impact on a person than merely reading about them, or hearing another person describe them. These are the experiences which are stored up in the mind, and which can be drawn upon to illustrate a point. How much greater is the interest aroused in a group of listeners by such a statement as, "I heard yesterday, for the first time this year, a chorus of Common Tree Frogs," than by, "According to most authorities, Common Tree Frogs should be calling now." On the one hand is a realization, by the listeners, that the speaker has been out, has identified the calls, and is now sharing his experience. On the other hand is a flat statement which merely indicates that the speaker has read a book or two. Which of the two examples might stimulate the listeners to go out and hear the calls for themselves? The answer is obvious—especially if the instructor is then able to produce a jar containing a living specimen of one of the frogs he has been describing. Visual aids are recognized as a good means of amplification; their value is increased considerably if they are the direct result of the instructor's efforts. Written field-notes, photographs, colored slides or films, recordings, all add interest to a

lecture, *especially* if the lecturer is able to say, for example: "I took this slide while I was on a trip in Oregon in 1954." In other words, field-study is a good method of building up material which can be used for reference and demonstration.

To stress a previous statement, if the museum instructor is to be encouraged to undertake field-work, the department by which he is employed should, if possible, cultivate his interest by giving some assistance. This could take the form of allowing time for such projects, or even of providing limited funds toward defraying any incurred expenses.

The Department of Public Instruction at The American Museum of Natural History has such a policy. For those members of its staff interested in studies in the field, there is always the probability of willing cooperation from the administration. The benefits from this outlook are evidenced by the increase in interest of the teaching staff and by the variety of programs which have been put into effect. These programs have included many field-trips led by Museum instructors (including one to Mexico and Central America), courses in various phases of natural history (given in various localities *in the field*), a nature program for the adult blind (*in the field*), and work in organizing and running children's museums. From these and other activities have come collected materials from many areas, for use in this and other departments, frequent additions to the Museum's Slide Loan Library, and various exhibits in the Natural Science Center for Young People—another departmental program.

Some of these projects are undertaken on "Museum time"—many are not. But regardless of when they take place, they most certainly stand or fall on the initiative and specialized abilities of the museum instructors connected with them.

Field-work helps to build these qualities.

Artificial Plants

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For centuries, peoples of all nations have made artificial flowers and foliage by hand. A great variety of materials have been used: the Egyptians used stained horn shavings; the Romans used gold and silver; the Chinese used rice-papers; the Japanese, the pith of bamboo; and the Italians dyed cocoons of the silkworm and made them into flowers. South American Indians utilized feathers for their purpose, while our North American Indians cut flowers of buck-skin, decorated them with colorful beads and quill work, and attached them to their wearing apparel. Natives of the South Seas have made sprays of flowers from dainty shells.

In our own culture, many fabrics, papers, and plastic materials are now being made especially for commercial concerns to use in the manufacture of artificial flowers and foliage. Millions of dollars are spent annually by milliners, department stores, and window and interior decorators to buy artificial plants.

With this long heritage in mind, it is no wonder that the art of making life-like models of plants has long been an important aspect of museum exhibition work. (Fig. 1) Habitat groups of forestry, mammals, birds, reptiles, insects, and undersea life, as well as of botanical exhibits, have utilized many forms of artificial foliage. In scientific exhibits, it is of the utmost importance to maintain a high standard of accuracy where permanency, texture, color, and anatomical features are to be created in a life-like manner.

To instruct the apprentice, and serve as a guide through the important stages in the construction of plant models, I have here described the

Fig. 1. Olympic rain forest scene, showing the use of artificial foliage.

methods generally used by the Department of Exhibition at The American Museum of Natural History. Of course, in this age of technical advancement, new materials and improvements in techniques are constantly being made. It is, therefore, necessary for the museum preparator to make it his business to keep up with these developments.

There are three different methods of making plant models, and they use three absolutely different materials: paper, plastic, or cotton and wax. The method chosen is dependent on many things, such as cost, time, available equipment, the distance from which model is to be viewed, and the experience of the preparator.

Collecting Procedure

Regardless of the method chosen, it is essential that all reference and research data be made available to the preparator. A careful color sketch, or color notes supplemented by detailed color photographs, dry herbarium specimens, and formalin specimens are absolutely necessary. (Fig. 2) When in the field collecting, conditions for making color sketches are sometimes impracticable. Therefore a color atlas will be found to be extremely useful.[1]

A stereo camera with color film will provide three-dimensional color transparencies that are invaluable in all aspects of plant preparation. A good exposure meter is indispensable for picture-taking in the field. Although photographs are invaluable, they cannot be depended upon to furnish all the information necessary to reproduce a plant. Basic necessities for a realistic reconstruction include color notations, sketches, and photographs combined with wet and dry plant specimens.

The use of a herbarium press will provide dried plants for purposes of study and identification. The specimens should be laid out in such a manner as to show both faces of the leaves or all sides of the component parts of the flowers.

[1] See the book review of Villalobos Color Atlas on page 92. Noting the atlas page and the coordinate lines, this color code may be used for a precise communication between one person and another of any color or hue—a communication not possible by mere words.

Fig. 2. Important field equipment used in the early stages of preparation for final plant reconstructions. Reading from the lower left hand corner and going clockwise: Villalobos Color Atlas, field notebook and pencil, herbarium press (containing dried specimens), formalin jar (containing wet specimens), watercolor sketch, watercolor set and brushes, dried herbarium sheet, identification tags and labels.

After the specimen has been catalogued, sketched, and photographed, it should be carefully wrapped in cheesecloth, tagged, and put into a jar or tank of water containing a 3 to 4 per cent solution of formalin. This will preserve its structure until work on the various parts can be started.

Woody branches or rigid stems of plants to be reproduced may be used in the finished model. The entire plant or shrub can then be collected and carefully packed for shipment to the laboratory.

Laboratory Preparation

In reproducing leaves and flower petals, whether using the old method of wax casting or the modern method of using plastic, it is necessary to make a mold of plaster of paris from the natural specimen. The procedure in making a plaster mold of a flower petal or leaf is about the same. The technique may vary with museum preparators. However, let us follow by word and picture the various basic steps I use in making a simple mold of a leaf.

A. Making a Plaster Mold of a Leaf for a Wax Casting

1. Remove the leaf from the living or formalin-preserved plant. Without changing the natural contour and undulations, very carefully cover the undersurface of the leaf with plaster. (Fig. 3)

2. Apply four or five very thin coats of plaster with a soft brush, allowing the plaster to set between each coat. When the leaf becomes slightly

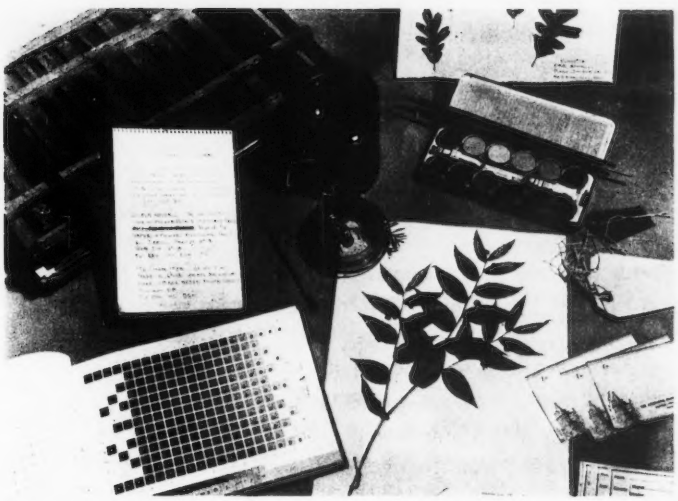

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 3. Applying of first coat of plaster to the underside of the leaf, to arrest the natural shape.

Fig. 4. The natural leaf with plaster undercoat embedded in soft water clay surrounded by a clay wall is now ready for pouring the top half of the mold.

Fig. 5. Clay being removed from the plaster leaf stiffener and top half of mold.

Fig. 6. Bottom half of the mold now ready to be filled. The plaster leaf stiffener in the lower right has been removed, keys have been cut, the top half of the mold has been greased, and a new clay wall has been set up.

Fig. 7. A completed two-piece plaster mold.

stiff apply a heavier and final coat of plaster with a spoon or spatula, being careful to keep plaster from the top or face of the leaf. After the plaster is thoroughly set, the leaf will hold its natural shape.

3. Prepare a mass of soft water clay or Plasteline and embed the leaf in it, plaster side down, modeling the clay carefully up to the edge of the leaf.

4. Clean the leaf with a soft brush and water, and build a wall of clay around it. The height of the clay wall is determined by the size of the leaf. For example, if a leaf is approximately 6″ long, each half should be cast about 1½″ thick to be of sufficient strength for preparing wax leaves, and a margin of about ¾″ should be left for keys. (See 9, below) The first half of the mold is now ready to be filled with plaster. (Figs. 4, 5, 6)

5. The amount of plaster mixture for the mold can be estimated by the size of the mold cavity. The water used for the mixture should be about 80 per cent of the cavity capacity. Sift the dry plaster into the bowl of water. As the saturated plaster sinks to the bottom of the bowl, continue

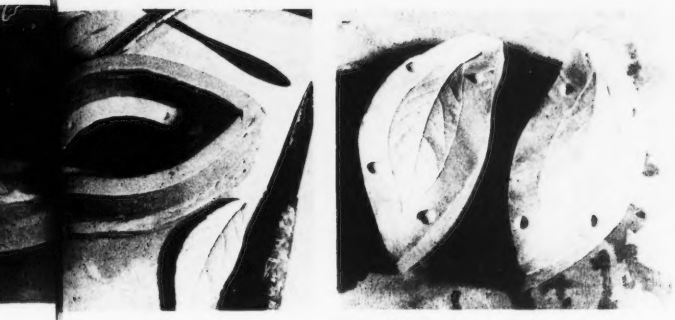

Fig. 7

to add plaster until it rises to the surface and absorbs all but a very small amount of the remaining surface water. Enough plaster has been added when it separates into cracks on the surface.

6. Stir the mixture to work out lumps. Jar the bowl to force air bubbles to the surface, and skim them off. The mixture should now appear like heavy cream.

7. Carefully pour this creamy plaster into one end of the mold, being careful to prevent air bubbles from forming on the leaf surface. If the leaf texture is very rough, apply the plaster mixture gently with a soft brush, or stop momentarily during the first application of plaster and blow on the covered surface of the leaf to expel bubbles that may have collected.

8. When the plaster is set, carefully remove both the clay from the underside and the plaster which first reinforced the leaf, thus leaving the leaf adhering to the new plaster mold.

9. Cut keys in the margin of the plaster mold so the second half of the leaf will be in perfect alignment with the first.

10. It is now necessary to use some separating medium between the two halves to prevent sticking. Either stearine, a mixture of stearic acid and kerosene, or lard oil have been found to be good separators. There are various commercial mold releases available which could also be used.

11. After applying the separating medium to the margin, place a few drops of water on the coated surface. Assuming the first half of the mold is still damp, the water should roll off and the second half of the mold should separate from the first without difficulty. If the water is absorbed, it is likely the halves will stick, so dampen the mold again and apply another coat of separator.

12. Set up a clay wall around the plaster mold and again pour a plaster mixture as in the first half, thus producing a two-piece mold.

13. The molds are now ready to be mounted on hinged clamps. Make

cuts on the back face of both top and bottom pieces to help key them to the hinged clamps.

14. Soak the molds in water and mount in perfect alignment to the hinged clamps with a stout mixture of plaster. After the plaster is thoroughly set on both halves, the clamp should be able to open and close in perfect alignment. The mold is now prepared for casting a wax leaf. (Fig. 7)

B. Preparing Tapered Wires for Wax Leaves

1. A malleable iron wire is used to support the wax leaf. Cut lengths several inches longer than the length of the leaf from tip to end of the petiole, and of sufficient size to support the leaf without sagging.

2. The bunches of wire are tapered by tying them securely at one end and spreading them slightly at the end to be tapered.

3. The taper is achieved by repeatedly dipping the wires into nitric acid to which about 30 per cent water has been added. (Fig. 8) Tapering wire with acid should not be attempted without the use of rubber gloves and the aid of an exhaust fan to draw off the poisonous fumes caused by the chemical action. During the dipping operation, rinse the wires occasionally in clear water to check on the taper desired.

4. After the wires are tapered by acid, they must be washed thoroughly in water to prevent acid burns on the hands.

5. The wires are then dried with a cloth rag, and the rust deposit is removed with fine steel wool or emery cloth. If working with acid is impracticable, wires can be pointed by grinding them on a carborundum wheel, disc, or belt sander. This process is much slower but is safer for the preparator.

6. A thin film of absorbent cotton is then wrapped around the tapered wires to be used, and the wires are bent to fit the contour of the midrib impression of the mold. Care must be taken to prevent fracturing the sharp edge of the midrib impression. If the leaf is very broad or is of the compound type, lateral supporting wires must first be soldered in their proper place to the main midrib wire before wrapping it with cotton. It is important to keep the soldered joints within the dimensions of the midrib of the natural leaf to prevent interference with closure of the mold when casting.

C. Preparation and Casting Wax Leaves

1. Wax leaf casts are made up of thin, even layers of absorbent cotton of a size large enough to cover the entire leaf impression of the mold, and saturated with melted wax.

2. Pure beeswax has proved to give the best detailed results. The wax

Fig. 8

Fig. 9

is melted in a double boiler over a low flame.

3. Once the wax has become liquified, oil tube color may be added to give base color of any desired shade. Very little pigment is required to color wax. Use only the minimum amount, lest the wax become emulsified and unfit for use. If white is needed, use Flake, or Permalba, never zinc white.

4. The preparation for casting or pressing the wax is now complete. Using warm water, submerge and thoroughly soak the mold mounted on the hinged clamps until air bubbles cease to rise.

5. Remove, blot water from the face of the mold with a damp cotton pad squeezed nearly dry by hand. Blow on the mold face to remove any water that may be trapped in the leaf crevices.

6. Now put into place the preshaped cotton-covered midrib wire.

Fig. 8. Wires being tapered by dipping in an acid bath.

Fig. 9. Pouring melted wax over cotton sheet in wax leaf casting method.

7. Over this place the prepared thin sheet of cotton (see 1, above), and pour enough hot wax over the cotton to cover the leaf surface completely. (Fig. 9)

8. After pouring, close the clamp immediately, apply moderate pressure by hand and allow the cast to cool. It will be found that the pressure, aided by capillarity, will force the wax into a thin sheet that engulfs the cotton and wire so that neither can be seen, and that the excess wax will be squeezed out around the leaf impression.

9. The secret of making good wax leaves, thin, free from chill marks, etc., is speeding the operation after the molds are removed from the warm water, keeping the cotton sheets dry, and making sure the midrib wires are well fitted.

10. If several clamps are manipulated in series, the first impressions will have cooled properly for removing by the time the second or third cast is poured. With each succeeding cast the above operation is repeated.

11. Minor casting defects can be repaired by tooling and touching up with hot wax, but it is advisable to make a new cast if the first is badly defaced.

D. Trimming the Wax Leaves

1. A slightly warmed razor or thin knife blade will be found useful in trimming the wax leaf impression. The edges of the leaf can be thinned by careful tapering of the underside with the blade. They can then be smoothed out by using fine sandpaper with a few drops of turpentine spread over the surface.

2. The final feathered edge is obtained by rubbing the leaf cast between the thumb and forefinger.

3. Remove the parting lines along the sides of the petiole with a slightly warmed spatula. Sandpaper the petiole and rub it with turpentine.

4. Bend the petiole to the desired shape. The leaf may also be warmed over a Bunsen burner to give a variation of shape and a life-like appearance to a stiff-looking cast.

5. The wax leaf is now ready to be sprayed with color and the midribs stripped by hand. (Fig. 10)

E. Paper Leaves

1. In the modern habitat groups, the majority of leaves and flowers are

Fig. 10. On the right, plaster molds can be seen mounted on hinged clamps; on the left, absorbent cotton, wax castings showing leaf impressions untrimmed, trimmed, painted and assembled in clusters on a branch.

made of paper, coated with beeswax. This method is preferred, since no molds are required, the cost is lower, and the model is lighter in weight. The latter is a very important factor, as it permits a larger number of leaves to be assembled on the delicate terminal branches.

2. Many different kinds of paper are used, depending upon the shape, texture, strength or transparency desired. Tough brown wrapping paper can be used. Heavy Japanese vellum can be used because of its long staple fibers, its strength and non-tearing qualities. The very thin onion-skin paper can be used for its translucency and lightness of weight. The desired effect determines the best type of paper to be used. Among the most commonly used is double-weight crêpe, which offers many advantages because of its stretching qualities. Some experimentation may be necessary to determine the best paper to use for close duplication of actual leaves or flower petals.

3. The size and number of leaves to be made, as well as the equipment one has to work with, determines the method of cutting. When only a few leaves are desired, cut them with a scissors, and vein the cut blanks by hand. To do this, place the blanks, one at a time, on a soft pad of blotter paper, and then press the veins into the paper with a blunt metal tool.

4. For a large job involving mass production, steel cutting and veining dies are often used. (Figs. 11 and 12) When using these it is necessary to have a cutting block, a stamping press, and a special mallet. This is the standard type of equipment used by all commercial flower and foliage manufacturers. The method is time-saving, since one operator can cut and vein hundreds of leaves per day. However, unless leaves are needed by the thousands, the cost of dies is prohibitive.

5. A practical method commonly used for cutting or blanking out

Fig. 11. Crêpe paper leaves being cut by steel dies as used in mass production.

Fig. 12. Crêpe paper leaves being veined by steel impression dies with screw-type press.

Fig. 13. Crêpe paper that has been pressed into pads being cut by bandsaw.

Fig. 14. Leaf blanks being veined by hand with a blunt metal tool over a pad of blotting paper.

Fig. 15. Paper leaves having been cut, veined, and wires cemented, are being shaped by hand.

Fig. 16. Paper leaves that have been shaped are dipped into melted beeswax.

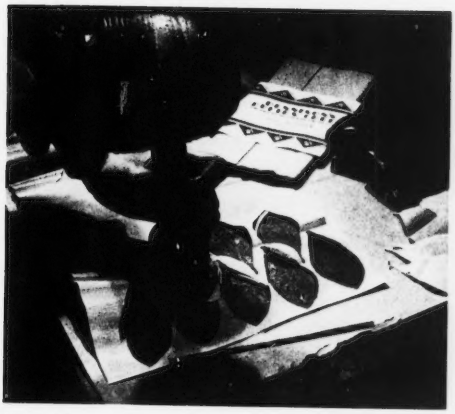

Fig. 11

Fig. 12

Fig. 13

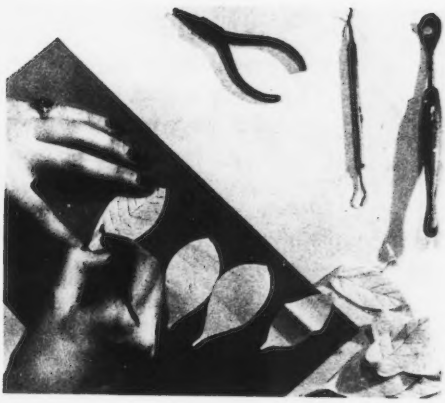

Fig. 14

Fig. 15

Fig. 16

leaves is to cut them out by jig or band saw. (Fig. 13) The jig saw, although slower, is preferred, since a much finer blade can be used, thus enabling the operator to make fine detailed cuts. Pile the paper to be cut into pads and place them under a hydraulic press (a book press or vise will suffice).

6. Place a stiff cardboard or mounting board on both top and bottom of the pad and hold it tightly together with light cleated nails.

7. Outline the leaf pattern on the top cardboard, being careful to stay clear of the nails. Each cut will produce as many leaves as there are sheets of paper in the pad. The number depends upon the type of paper used.

8. The veining is then done as in 3, above. (Fig. 14)

9. Wires covering the entire length of the midrib are usually fastened to the undersurface of paper leaves with plastic cement (Duco).

10. Shape the leaf by hand, dip it into melted beeswax, remove, and twirl it quickly to throw off excess wax, leaving an even, thin coat. (Figs. 15 and 16)

11. To make petioles, wrap the wire with cotton to the desired length, apply melted wax with a spatula and shape with a hot tool. Finish with fine sandpaper and turpentine.

12. For leaves that are not to be examined too closely, use a cambric or plastic tubing (used commercially to insulate electric wires) to simulate petioles. The tubing is obtainable in various diameters and can be cut to proper lengths with scissors. Slip the tubing over the wire and hold it in place with a spot of plastic cement. The paper leaf is now ready to be sprayed with color.

F. Plastic Leaves

Plastic sheets of cellulose acetate and other brands of synthetic thermoplastic resins are being used in an ever-increasing quantity for molding or drawing operations. Leaves fabricated from this medium possess many advantages where detailed inspection is possible. The material is both light in weight and transparent, requires a minimum of supporting wire, and is less subject to curling with age. There are two methods commonly used, depending on the number of casts required. Regardless of the number of leaves needed, a plaster mold must be made of the top side of the leaf (See A, above).

1. Limping Method

a. Where only a few casts are required, the counter-mold is made of Plasteline. By pressing small bits of Plasteline against the face of the plaster mold, after the natural leaf has been removed, a counter-mold with every detail can be made. Build up the clay mass to form an even cushion about one inch thick or more, depending upon the contour of the

Fig. 17. Plastic sheet of acetate being limped with acetone before being pressed into shape.

leaf. Place a small block of wood on top for reinforcement.

b. Cut plastic sheets of cellulose acetate of a deep draw type .008 or slightly heavier, depending on the size of the leaf, to insure coverage of the mold.

c. Submerge a cut sheet in a solution of 60 per cent acetone and 40 per cent water, and leave it until it becomes limp. (Fig. 17) The length of time required in the acetone bath is dependent upon the thickness of the sheet. Most leaves pressed from .008 stock require about 80 seconds to limp. Occasionally acetone will have to be added to keep the solution up to full working strength. Use a flat tray to hold the solution, and cover with a sheet of glass to minimize evaporation.

d. After the plastic sheet is sufficiently limp, place it over the water-dampened plaster mold, and quickly work it into the general contours of the leaf impression with a piece of cotton saturated with the acetone solution. (Avoid leaving any drops of solution on the face of the mold.)

e. Carefully put the top Plasteline or counter-mold in place and with moderate pressure make the impression.

f. A weight may be used to hold the pressure for five or six minutes while the acetone evaporates sufficiently to permit removal of the cast. Swift but careful handling in the procedure is important, since the sheet begins to set upon removal from the solution.

g. Trim the leaf impression with a pair of scissors.

2. Vacuum Forming

a. A plaster mold of the top side of the leaf must be made (See A, above). However, no keys are necessary. This process of shaping the thermoplastic sheets by means of air pressure or negative pressure (vacuum) is used on multiple or gang molds when a great number of leaves are needed. (Fig. 18) It is important that technical advice be obtained from an experienced concern before starting this method. Due to the elaborate equipment needed, it has been found advantageous to contract this type of work out to commercial plastic fabricators. However, preliminary steps, i.e., molds and gang molds, must be done in the museum laboratory.

b. Perforate with air holes (through the plaster) and around the

Fig. 18. Acetate sheets before and after vacuum forming. Upper left shows gang mold.

margin of each leaf the plaster mold surrounded by a wooden framework which encases many smaller leaf molds. Fit a frame to the mold and place it over a vacuum plate.

c. Clamp the plastic sheet air-tight or hold it down by a pressure plate over the frame.

d. The plastic sheet is then heat-softened and the vacuum valve opened. This draws the sheet down against the mold, thus forming it.

e. Remove the heating element. The vacuum holds the sheet against the mold until it becomes fixed in cooling.

f. In both of the methods described, the plastic sheet acts like a rubber membrane until the time its final desired shape is fixed by evaporation or by cooling below its softening point. The vacuum-forming has considerable dimensional stability over the limping process.

g. In either case, the leaves must be trimmed by hand, and a short tapered wire cemented in the midrib groove. Make the petiole as described in the paper leaf or cotton and wax process. Then spray the leaves with color.

G. Petals

Flower petals are usually reproduced in plastic, using the same limping process described in leaf-making. The fine, frost-like texture, so characteristic of many flower petals, may be obtained by sanding the cellulose sheet on both sides with a fine sandpaper before placing it in the softening solution. If, however, the flowering plant is not to be viewed too closely, the petals may be cut from single or double-weight crêpe paper, veined if necessary, shaped by hand and dipped in melted beeswax. Petals are seldom made today by the cotton-wax method, commonly used a few years ago. Wax becomes brittle with age, and extremely fragile. Success in making life-like artificial flowers comes only with experience, when the student has worked with the various mediums and is able to recognize the possibilities and limitations of the materials and can judge which is best suited to the problem at hand.

H. Stamens, Pistil, Etc.

1. Stamen assemblies are often made of ordinary sewing thread which has been dipped in hot wax.

2. The thread is cut into the desired lengths, and anthers may be made by additional dipping of the ends or by adding wax with a hot spatula until the desired size and shape is achieved.

3. Stiff brush bristles make authentic-looking stamens, and may be shaped by being drawn over the blunt edge of a wood or metal tool. Wax can be added to make up the anthers.

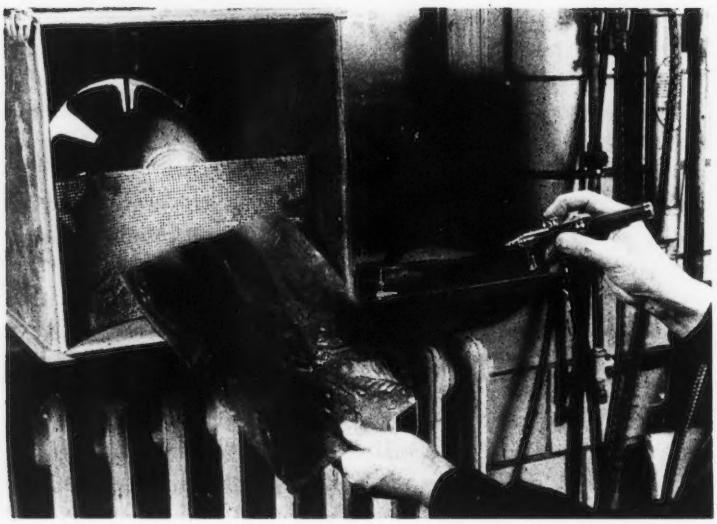

Fig. 19. Lacquer being sprayed on thermoplastic sheet that has been shaped by vacuum forming.

4. Nylon bristles are often used. They are obtainable in various diameters, and make excellent stamens because of their translucency. Nylon may be shaped by heating over a low flame.

5. The anthers may be formed by placing the tips of the nylon bristles near an open flame and withdrawing them instantly. This causes them to melt, forming a small plastic ball.

6. The burning of fine copper wire by flame to form an anther is also possible, if that medium is being used.

7. The calyx may be cast from plastic sheets or fashioned in crêpe paper that may then be coated with wax. If the calyx is deeply cupped, the main body may be made up with pre-shaped pieces of plastic or paper that can be cemented together.

8. The pistil is usually fashioned on a tapered wire that has been wrapped with a thin film of cotton and saturated with wax, thus providing a support for the stamens, petals, calyx, etc.

I. Coloring

1. Coloring is most successful when applied with an air brush, (Fig. 19) regardless of the method chosen to reproduce leaves or flower petals. This is because it is very difficult to apply either oil paints or lacquer with a

hand brush in thin enough coats. Coverage and gradation of color must be obtained without an opaque and overpainted effect.

2. Gradation and depth of color is achieved by the blending of different values of the same color. With the majority of leaves and almost all flower petals, a certain amount of translucency is necessary to give a life-like appearance. There is a knack to coloring which will be acquired only through considerable practice. If your colors appear muddy and dark after they have been applied, do not attempt to freshen them up with another application of bright color. It is wiser to remove the undesired color and start anew.

3. One must always bear in mind what effect the under color or base color of the wax will have on a leaf after it is painted. If possible, mix your colors under the type of light used in your exhibit, or test a few of the finished leaves under the light before assembling. A good practice is to keep the shadowed side or bottom of the leaf light in color when exhibiting under artificial lighting conditions, since you do not have the strong reflected light that sunlight has on natural leaves outdoors.

4. On the multi-colored leaves of definite patterns, stencils are often used to control the color design.

5. Oil paints are used on leaves with a wax base, while lacquer is used only on plastic leaves. The disadvantage of using oil paints on plastic is that they scratch readily. Midribs and veins are stripped on in oil colors by hand with a fine line brush.

6. After the paint has dried, a coat of liquid wax is often applied to give a waxy luster to the top surface of the leaf, if needed.

7. The soft, downy fuzz sometimes found on the underside of leaves and on fruits, and the hair found on plant stems, is simulated by fine cotton or silk flock. A thin coat of flat varnish is applied to the surface, and the flock is dusted on when the varnish becomes tacky. In some cases, a small amount of varnish may be added to the paint for flocking the underside of leaves. The surplus flock can be gently blown off, and often a very light spray of color may be applied, if necessary.

J. Assembling

1. It is difficult, if not impossible, to give definite rules for assembling various kinds of leaves on different types of plants or branches. So many variables affect the problem that only analysis of the specific job in question will produce the correct answer. In general, when fastening leaves to branches, a small hole is bored through the stem. (Fig. 20) The leaf wire is cut on an angle, pushed through the hole and clinched back into the stem. The delicate terminal tips often have to be made up by soldering each leaf to a main supporting wire, using cotton and wax or plastic

tubing to simulate the woody part.

2. On branches that are too fragile for boring holes, bind leaves light in weight securely to the stem with fine wire. Cover the tie wire with a thin film of cotton and coat it with glue.

3. Take care not to overload the branch, lest it twist out of shape. Keep materials to a minimum weight, so that the finished branch will rigidly support the leaves placed upon it.

K. Fruits and Vegetables: Plaster Molds

Objects such as fruits, etc. are usually cast in wax, or, in some cases, carved from balsa wood. (Fig. 21) When casting in wax, a piece mold of plaster is required. The number of pieces must first be determined because of the undercuts to insure the mold release of the wax cast. Two, three, or more pieces are often necessary.

1. In making a three-piece mold of an apple, first cast the lower section, as seen in Fig. 22.

2. Place a water clay margin about ½" thick around the fruit, which is bottom end up.

Fig. 20. Holes being bored in natural branch with flexible shaft for attachment of artificial leaves.

Fig. 21. Fruits being carved from balsa wood.

Fig. 22. Three-piece mold of an apple, and a finished fruit-bearing twig.

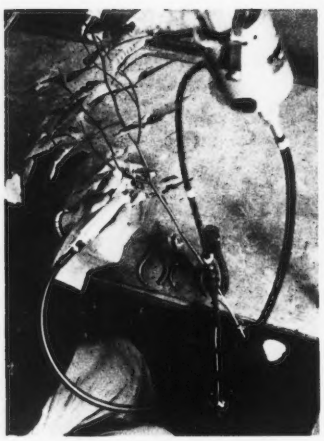

Fig. 20

Fig. 21

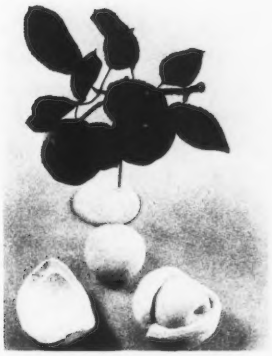

Fig. 22

3. Wrap a wall of clay around the marginal clay, and carefully pour plaster into the mold cavity.

4. After the first section has set, the clay is removed, cut keys into the plaster mold margin, and apply a parting agent.

5. Place a clay margin strip up to the parting line from the top and center of the fruit, and down on both sides to the plaster margin.

6. Set up a clay wall and pour the second half. When the second piece has set, again remove the clay and cut keys into the second section. Coat the plaster margin with the separator.

7. On the third or last section, no clay margins are needed. Set up a plaster wall, and fill the cavity with the plaster.

8. After the plaster is set, the three pieces should be able to be removed from the apple with comparative ease.

9. In making the wax cast, thoroughly soak the mold in warm water until air bubbles cease to rise.

10. After removing it from the water, blot the mold face dry with a damp cotton.

11. Bind the two top pieces of the mold (Nos. 2 & 3) together with light wire.

12. Pour wax that has been melted over a very low flame into the two bound halves within a half inch of the open end. Quickly put the bottom in place and hold firmly while rotating the mold until the wax has congealed. This makes a hollow cast.

13. After ten to fifteen minutes the mold should open with comparative ease and a perfect cast ensue.

L. Fruits and Vegetables: Rubber and Latex Molds

Latex, or liquid rubber, molds have many excellent qualities for wax or plaster castings, especially where undercuts are a major problem in

reproducing botanical specimens. (Fig. 23) Constant research and development have removed the imperfections found earlier in materials of this type. Application may be carried out by brushing, spraying, pouring, or dipping. No separator is needed to release the rubber from the specimen, whether it is preserved in formalin, alcohol, or is in a natural state. There are many types of liquid latex made by various manufacturers. Some are self-curing, others require low heat treatment. Fillers are added to the mix or to subsequent coatings to build up thickness to the mold, according to manufacturers' recommendations. The latex used is usually low in viscosity, since an accelerator has been added.

1. When the latex is applied by brushing, care must be taken to provide a smooth, even first coat, with all air bubbles carefully brushed out.

2. After the object to be cast has been covered with ⅛″ to ¼″ of latex and all undercuts have been filled, allow the rubber to cure, and make a two-piece jacket mold of plaster over the rubber form.

3. After the plaster has set, remove the pieces and cut the rubber down on one side with a razor blade—just enough to release the object being cast.

4. Cut a hole both in the plaster jacket and in the rubber mold for pouring the melted wax.

5. Use clay to seal the pouring hole after the wax has been poured, and slowly rotate the mold until the wax has become solidified. No preheating is necessary with latex molds, since the mold will stretch and release the finished cast with ease.

6. When making a latex mold by the pouring method, make the plaster jacket first. First cover the object to be cast with clay approximately ¼″ thick. (Fig. 24) Then make the case mold over the clay form. After the plaster has set, open the pieces and carefully remove the clay. (Fig. 25) Place the object to be cast in the case mold and hold it in position by supporting wires. Then pour the liquid rubber into the cavity. (Fig. 26)

7. Allow the latex to cure over night or to cure within an hour by low heat treatment.

8. The casting procedure is the same as that described above. It is recommended that the museum preparator follow the specific instructions listed by the manufacturer for each latex product used.

M. Suspending Fruits or Vegetables

1. If the cast fruits are to be suspended, wrap the supporting wires with cotton and hook them through the hollow casting where the stem emerges.

2. Make the wires secure with melted wax, and model the stems by hand.

3. In cases where the fruits are small and cast in solid wax from simple two-piece plaster molds, insert the supporting wires in the wax just before it congeals.

4. Plastic tubing is often used to simulate the tiny stems.

The information presented in this article is intended only as a general guide through the many procedures involved in the making of plant reproductions.

Since many variations in both methods and the use of materials can be achieved either through trial and error or experience, the museum preparator is certain to develop specific techniques best fitted for the job at hand.

Needless to say, this article should not be construed as definitive. Undoubtedly other organizations have methods that supplement or com-

Fig. 23.

Liquid rubber, accelerator, and finished mold.

Fig. 24

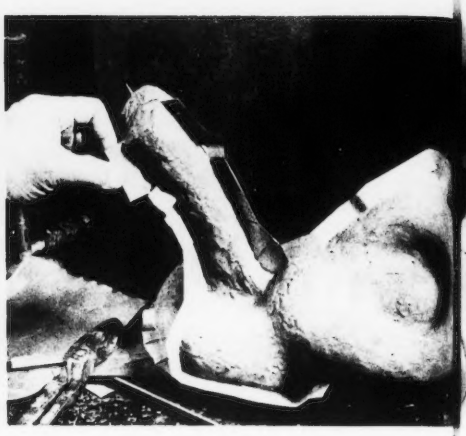

Fig. 25

26

plement (or disagree with) those in use at The American Museum of Natural History. It would be of great interest to this department to hear of variations, new departures, or time-savers now in use elsewhere.

Perhaps it would not be amiss to append one thought here which, although virtually a truism, must be kept constantly in mind. No techniques or methods, no matter how highly developed or skillfully carried out, can succeed in giving life to artificial plants unless the preparator is himself completely familiar with all aspects of the plant in its growing state. He must have observed nature itself with such care that he will recognize, not only by his artistic instinct, but also by his highly trained eye, any fold or permutation of an artificial plant that is not consistent with its appearance in nature. You can be sure that even though the preparator may not notice any discrepancies, some museum visitor will!

(ED. NOTE: Two additional papers by Mr. Petersen will appear in future editions of *Curator*: Preserving of Plant Material, and Assembling the Habitat Group.)

Fig. 24. Clay being formed on the model.

Fig. 25. Separators for the case mold being put into place.

Fig. 26. Liquid latex being poured into the prepared case mold.

PHOTOGRAPHS BY LOTHAR P. WITTEBORG

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SOURCES OF SUPPLY

The following list should not in any way be construed as an endorsement by The American Museum of Natural History for any of the products or companies mentioned. The information is given solely as a convenience for CURATOR readers, and represents some of the current sources of supply being used by the Department of Exhibition.

Plaster Molding: Knickerbocker Plaster Co., 522 West 38 St., New York 18, N.Y.
Castone: White Dental Mfg. Co., 220 West 42 St., New York 18, N.Y.
Water clay: Stewart Clay Co., 133 Mulberry St., New York 13, N.Y.
Plasteline: Schneider & Co., 129 Columbus Ave., New York 23, N.Y.
Cotton (Johnson & Johnson): Industrial Drug Supply Co., 110 Spring St., New York 12, N.Y.
Wire: Paramount Wire Co., 98 Bleeker St., New York 12, N.Y.
Wax: Theodore Leonhard Wax Co., Inc., Heledon, Patterson 2, New Jersey
Oil colors (tubes): Schneider & Co., 129 Columbus Ave., New York 23, N.Y.
Chemicals (nitric acid, etc.): Fisher Scientific Co., 635 Greenwich St., New York 14, N.Y.
Rubber: Cementex Co., Inc., 336 Canal St., New York, N.Y.
Flock cotton and silk: Arthur Brown Co., 2 West 46 St., New York 36, N.Y.
Formalin: Amend Drug & Chemical Co., 117 E. 24 St., New York 10, N.Y.
Glycerin: Fisher Scientific Co., 635 Greenwich St., New York 14, N.Y.
Cellulose Acetate (sheets): Commercial Plastic Co., 630 Broadway, New York 12, N.Y.
Duco Cement: S. D. Jacobs Co., 749 Avenue of the Americas, New York 10, N.Y.
Stearine: Ehrmann-Strauss Co., 200 W. Houston St., New York 14, N.Y.
Green soap: Amend Drug & Chemical Co., 117 E. 24 St., New York 10, N.Y.
Varnish, turps, benzine, etc.: Atlas Paint & Varnish Co., 1864 Lexington Ave., New York 10, N.Y.
Lucite tubing and rods: Berton Plastics Co., 585 Avenue of the Americas, New York 11, N.Y.
Vinyl tubing: Guy Industries, 43 White St., New York 13, N.Y.

The Impact of the Museum in the Hinterlands

K. ROSS TOOLE, DIRECTOR
HISTORICAL SOCIETY OF MONTANA, HELENA, MONTANA

As an historian by training, I am as conscious as the next man of the dangers inherent in generalizations. I am also conscious of the fact that when such generalizations involve a kind of psychoanalysis of the people of a whole region, there is added peril.

But in the process of explaining what I think is happening in what I choose to call the "hinterlands" (referring specifically to Montana, Idaho, Wyoming, and Alberta), I am at a loss to avoid psychological generalizations. What I have to say has little statistical support. It is subjective. But the ideas which follow have been germinating for some time. If they are in part valid, their importance lies in the fact that in the almost passionate interest in good museums which is presently percolating into this region, and probably into the Great Plains region as a whole, there are important lessons to be learned by museum people.

Essentially, the interest in the hinterlands *is* in good museums. The "passionate few," without whom no progress of any kind is made in cultural matters, are knowing and critically demanding. But there is a much broader base of interest than the "passionate few," and the trained museum man who underestimates the perception of his hinterland critics is, in my estimation, in for trouble. And God help him if he condescends. The stranger who walks into his office to complain about the quality of the labels has probably just returned from the American Museum, where he had a long talk on the subject with the Director.

NOTE: This article is here printed essentially as it first appeared in *Clearing House for Western Museums*, Nov., 1956, Newsletter 201, pp. 991-996.

In any event, the interest in the hinterlands is strong and active. It seems also to be quite recent. It is important, it seems to me, for the museum people to know how and why that interest came about. Only by understanding the nature of that interest can museum people make and run the kind of museums the hinterlands want and need.

II

The people in the hinterlands (with the exception of the residents of such urban centers as Denver and Oklahoma City) suffer from a kind of inferiority complex. They are at once intensely proud of their vast, rugged land and somehow embarrassed by what they consider to be its cultural backwardness. They are, moreover, sensitive about a certain economic colonialism which operates to the region's detriment. They reach out eagerly, therefore, for the physical manifestations of culture—for good museums, good music, good literature, good theatre, and good art. Traveling orchestras, ballet troupes, and concert performers are often amazed and refreshed at the uninhibited enthusiasm with which they are received.

The average resident of the hinterlands, like the average American, is peripatetic. When he goes East, his criticisms of urban living are apt to be caustic. But when he comes home to look around him, it is with a very critical eye and with a tendency to sink his teeth quickly into any *local* development which seems to him to be a harbinger of cultural maturity. He is not easily duped because he has a standard of comparison. To such a man, the good museum is the reflection of a self-conscious people in a vast area, rich in natural resources, but poor in people, money, and home-owned industry. This person sees not only cultural advantage in museums, but also an opportunity to explain himself and his land to outsiders. The economic motivation is often more powerful than the cultural. I do not mean to imply that the museum serves only a propaganda purpose. I do mean to imply that it should reflect at once the pride and hurt of the people and the land. If it doesn't, it will not be their museum and it will not keep their support. This is a vague thing, but an important one. It makes of the museum a pragmatic instrument. No museum director in the hinterlands ought to assert his professionalism in violation of that concept. He should not see in his museum a means principally of elevating low taste or of experimenting with *avant-garde* movements. The museum ought not, in other words, to be superimposed on the community. It ought to reflect what the community is—and what it might be—and, historically, what it once was.

If it operates in that broad context, the hinterland museum is capable of performing real services. Before I describe these services specifically, however, let me invite your attention to the fact that almost all of them

involve the filling of a void. In a sense, the museum steps into a sort of vacuum. There is little or no competition, because other agencies either can't or aren't operating effectively in that realm.

For example, sparse population has made publishers avoid textbooks which cover the area. Find, if you can, a really good high school or grade school text on the Intermountain West—or good state histories, or work books. They don't exist because there is no publishing money in them. The consequence is that schools often have no tools with which to teach state and local history. A generation (perhaps the *first* in the hinterlands) has matured with a strong sense of the importance of the region's heritage, yet this generation finds its children learning little or nothing of history in the primary and secondary schools. Since the war, a good deal of parental indignation has been directed at educators in this connection. The point is that this is grist for the museum. A vacuum exists, and a museum school program is received by parents and teachers alike with open arms. Museum publications are eagerly distributed and used. The hunger is almost voracious. Needless to say, there are a lot of parents and a lot of teachers, and they will quickly and avidly support any museum which begins to fill the void. Museum school programs such as lectures, slide shows, special tours, publications, and traveling exhibits are not merely facets of a general education program designed to acquaint students with their heritage. They *are* the program. In most sections no other exists. It is merely a question, therefore, of how much the museum can do in this respect. *Any* effort is rewarded with strong support.

Secondly, the hinterland museum finds supporters of another type. The school program and its educational aspects are quite secondary to this person. He is the local, state, or regional booster. Nine times out of ten he is a businessman. His kind is legion; his hallmark is tourist statistics. Like parents and teachers he is indignant. He is mad and frustrated by the activities of the poverty-stricken or unimaginative chambers of commerce and state and local booster organizations. But he ardently believes that if only tourists knew something about this wonderful state, they would stay longer, spend more money, and come back oftener. It would, in other words, be good for business. And he is right. This man will become the avid supporter of the good museum because he can see and hear what it does. He is practical. He will respond to a practical, concrete tourist museum program.

There is yet another way in which the hinterland museum gets support by stepping into a kind of vacuum and assuaging a kind of hunger. In areas predominantly urban, the average person is confronted with a bewildering number of things to do for entertainment. I think urban people seldom realize how deadly monotonous the really rural life can be. The

movies have endowed these dwellers in remote places with an ingenuity for self-entertainment they do not, in fact, possess. Corn husking bees, barn dances, sleigh rides, and other bucolic pursuits do not often interrupt the unremitting toil and deadly monotony of the dry land farmer, for instance. There is, hence, a yearning for entertainment. Again, the good museum has a chance to operate in this realm with little competition. Indeed, rotating displays and traveling exhibits are followed with an intense kind of attention.

Historians know that a region, like a man, goes through phases and rather predictable stages culminating in maturity. The long-mature East seldom realizes how close portions of the West still are to the raw formative period. Montana has only been a state for sixty-seven years; Wyoming for only sixty-six years. Oklahoma has been a state for only forty-nine years. The people in the frenetic building time were rarely contemplative and rarely aware of their role as makers of the mold. They were too busy just staying alive. Not until the 1930's did institutions that mark cultural maturity (which were reflective in nature, or, you might say, introspective) begin to arise. No one was much interested in the past because, in effect, it was right there. There was no aura of antiquity and there was no romance to it. After all, Grandpa still lived in the spare room and bored everyone with his talk of the Vigilantes and the Constitutional Convention. Every town had residents who were born there when there was no town. If you were curious about the past, you simply asked old Simon down the street. You didn't need a museum to tell you the story. But mostly people simply weren't curious. Their heritage lived with them—almost a part of the present.

But the generation now in their forties and fifties awoke to find Grandpa and old Simon gone—and their stories with them. The post-war building boom razed the old houses and buildings. The old blockhouses, forts, even whole ghost mining camps and other historic places suddenly disintegrated and were gone like the One-Hoss Shay.

This coincided with a great unease and insecurity which resulted from war, and the sudden knowledge of vulnerability. It was, indeed, one world—and not a very stable one. Thus the natural process of maturation, plus the sudden need for some kind of rudder, turned people's minds and interests backward. This happened, of course, all over the country. In the hinterlands, just emerging from their formative periods, it happened with a vengeance. A good museum is thus seized upon by people who, twenty years ago, would never have visited it, let alone supported it. Now it is the monument to a heritage they have suddenly found precious. They are all the more ardent because of the newness of their realization.

But you will note that most of the museum supporters I have described

are interested in a *story* being told. They are not interested in curiosities, stuffed fleas, pickled club feet, and two-headed calves. They want the museum to get a point across, to tell a story. This obviously cannot be done unless there is, first, a carefully thought-out plan; second, a skillful, artistic execution of the plan; and third, a dedication to continuity and coherence. What these people demand, in other words, is that a story be told that sticks together in terms of content and drama. Without coherence, the museum has no point for them. They may not know that color, lighting, texture, glass reflection, traffic patterns, case construction, labels, and a host of other things enter into the coherent telling of the story. But they do conceive of the museum as a storytelling instrument, and they are quick to know when the story isn't well told. Enthusiastic, wide-spread, and sustained support will only be given to the *good* museum.

III

The creation and maintenance of such a museum poses certain problems, some of which are ubiquitous, but many of which relate specifically to the area. State museums in the area are apt to run into immediate trouble because there is no precedent for either their construction or operation. Problems which are routine with older museums elsewhere can quickly become critical in the hinterlands because of this fact. A good museum can't really be made within the rigid framework of state, county, or municipal purchasing regulations and contracts. No provision exists to enable them to buy what their special needs require. Any state, county, or municipal museum in our area will probably encounter a kindred attempt to force it into an impossible bureaucratic mold.

Secondly, any state or municipal museum will encounter the politician. The tax base in the entire area is narrow. There is fierce competition for appropriations. With the appropriation comes the inevitable attempt to control, to administer, as well as to legislate. The last session of our own legislature, for instance, brought with it a unanimously endorsed senate report which directed us to hang permanently some 290 ghastly pioneer portraits, which we have in storage; to hang permanently also the portraits of ex-governors and prominent politicians. This would have used up all of our precious gallery space and most of our museum space. We simply refused to do it, took our case to the newspapers, wrote editorials in our magazine, stirred up a great fuss, and sat back to await the next legislature. It convened in January, investigated us, roasted us, and then gave us a 35 per cent increase in the budget.[1]

There are, of course, always the devotees of the old rat's nest collection,

[1] This, I like to think, proves it is not always fatal to speak out.

whose favorite items fail to show up in the new museum. It is useless to explain that dried apple dolls, stuffed boa constrictors and a pan that George Washington may once have washed his hands in have no place in a good western museum.

There are, of course, the usual "agin-ers," complainers, and ordinary crackpots. If you add together all these opposers, from the politician to the crackpot, you have a fairly formidable crew. I suspect that such types trouble museums everywhere. But, again, because the hinterland area has little or no precedent to go on, and because the good museum is a new rarity, not a time-honored institution with its own traditions, the opposition as well as the museum operates in fertile ground. It is precisely the lack of precedent and of institutional tradition that accounts for both the ardent support and the dangerous opposition a good museum engenders.

IV

State, municipal, or private museums in this area are going to have to raise money above and beyond appropriations if they wish to operate effectively. This is so simply because there isn't enough tax money in the area to provide a firm base for a good museum. Our own museum operates now on about $100,000 a year. Of this amount, we must raise or make about $60,000. Most museums, of course, suffer from a shortage of funds wherever they are located. But the reliance on private capital in the hinterlands carries with it a special peril. Herein lies a basic pitfall and the first of the hinterland museum director's temptations. Corporate sponsorship is not very hard to come by. The temptation to forsake the basic plan, and, in effect, simply to sell individual exhibits to individual companies to memorialize their own kinds of business enterprise is a great one. So the oil industry *should* have only a certain portion of the space in true historical perspective and according to plan. But here is an oil company with $10,000 to sponsor its own exhibit. Of course, there are certain points they want to get across about the company. But $10,000 is $10,000 and the director figures the exhibit would actually only cost about $4,500. Then he could use the profit to do a really effective Lewis and Clark diorama. Is it worth it? No. It's the beginning of the end. But the temptation is a strong one, especially when the beleaguered director looks once more at his budget.

If he survives that temptation, there are others. Especially after a few years of the war of attrition, not only the director, but also the entire staff begin to dread a head-on collision with persistent opponents. Legislators in particular, because of the really vast power of destruction in their hands for a chaotic sixty days every two years, are to be feared. Why not, then, keep the peace and hang a few ex-governors' bilious portraits? Why not

display a few petticoats and get the Sons and Daughters of the Pioneers off the institution's neck? Why not hire a few influential local artists and let them botch up a few diorama backgrounds? Why not open the dike a little to relieve the pressure? The director has long since found that temporary displays won't do it. Why not, then, compromise?

The answer, of course, is two-fold. If a new institution gets off on the wrong track during the formative stage, it has, in the vernacular, had it. If it compromises to please the special interest critics, it will lose the support of the vast majority of its friends—and that very quickly. The opponents of the good museum are far more vocal than either their cause or their numbers warrant. They should be resisted implacably.

The opportunity for the good museum in the hinterlands, specialized or general, is great. The services it can perform are real and needed. Those museums which now exist and those now being planned will look to professional people for experience, advice, and counsel. I am sure they will receive the best. In the next decade, I know that many of you will become increasingly aware of the stirrings out on the edge of things. When you counsel these people from the hinterlands, whether they come to you or you go to them, I hope you will bear their eagerness and needs in mind. I repeat that museums in that vast place should reflect at once the pride and hurt of the people and the land. That is what they want museums for, and that is what they ought to get.

A Summer Program for the Blind

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Of the many different types of programs undertaken by The American Museum of Natural History during the summer months, a project for the blind was the one which the Department of Public Instruction decided to initiate for the summer of 1957.

The Summer Camp for the Blind is located in Spring Valley, New York. Driving time from the Museum to the Camp is just one hour. The Department of Public Instruction felt the convenient location would afford the possibility of frequent inspections to study the natural phenomena of the area, of developing the projects by its own staff, and of directing the continuation of these projects by the staff of the Camp.

The Camp site has some fifty buildings for housing, providing administration services and recreation facilities for the more than 800 persons attending during the July and August period. The Camp is organized primarily for adults, but has facilities for accommodating family groups of which one or more members may be blind. Investigation showed that most of the blind are from the New York City area, while the rest come from adjacent cities and towns. Of these persons, 60% are totally blind while 40% are legally blind. Many are partially deaf, and a few are totally deaf.

The Summer Camp for the Blind, set in a beautiful wooded valley, has as a focal point a lake large enough for boating. Part of the Camp grounds —approximately ten acres—consists of lawns, shade trees and shrubs. Most of the additional thirty acres of the property is natural woodland with rambling streams, and a natural swamp region adjacent to the lake. Since the blind have confined themselves to railing-guided paths in the past, natural habitat areas have not been disturbed and are rich in plant and animal life. The rather steep hill area on the farther side of the lake affords an additional type of ecology.

It was partially because of the physical extent of the area, the ample housing facilities and the undisturbed areas for nature study that the Department felt it could offer a real service in the field of natural science to these handicapped people. After the preliminary surveys were finished, a program in natural science was suggested that would be initiated by personnel from the Museum and that would be carried to a conclusion by the counselors on the staff of the Camp. The plan was to divide the work so that it would be handled by three teams on three major projects.

THE FORMAL GROUNDS: This area includes approximately ten acres of lawns, trees and shrubs that surround the many buildings on the property. Since the blind spend most of their time in this area, it was felt that first consideration could be given to identification of the trees and shrubs here.

One suggestion was to place the identification near to the iron railing that borders all paths, so that the blind could recognize the presence of a sign from some marker along the railing. This sign could not only identify the nearby tree, but also could tell how to know the tree by the feel of the bark, and could possibly have an additional explanatory note. These signs would be annotated by Museum personnel and then turned over to the Camp administrators for the processing of the Braille signs in metal. Two Museum persons would work on this one project.

THE NATURE TRAIL: After tramping over most of the property to note

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 1. View of part of the formal campus of Summer Camp for the Blind. Some of the pipe-rail guide fences can be seen. Trees on this formal campus were provided with Braille labels made of copper.

Fig. 2. A camper "reads" a Braille label on a campus oak while museum instructor F. P. Marone, designer of the label, looks on.

Fig. 3. Campers on nature trail wait turns to examine bark. Museum instructor R. Hellmann helps first camper to establish contact.

Fig. 4. Camper, an enthusiastic octogenarian, explores the structure of a leaf with the assistance of E. Hellmann, museum instructor.

Fig. 5. M. Stryker, senior museum instructor (second from left) assists camper in nature museum while other campers examine the exhibits and "read" labels.

the various ecological areas, it was felt the Nature Trail should begin below the main administration building, continue around the lake area and finally reach the marshy region some 300 yards away. This trail would first be interpreted to the blind by one of the Museum workers. Later the counselors employed by the Camp would supervise the trail. The trail would afford the blind an opportunity to become acquainted with plant life that might not be found on the formal camp grounds. Here there was sassafras for the blind to taste, various bark and leaf textures to feel, and the spice bush leaves to crush for the smell. Poison ivy would have to be cleared from the area and a trail cut through. Repair work would have to be done on the old bridges that covered the spillways from the lake. With only two people working on this project in advance of the summer, only a part of the trail could be completed this first year.

NATURE-STUDY MUSEUM: It was the Department's feeling that the blind could gain greater understanding if they became acquainted with some of the animal life of this region. For this purpose a small pavilion was selected as a possible place to house this type of collection. The main problem here would be in obtaining a collection of nature materials such as local animals, geological specimens, nests of birds and insects, and other like materials. The Director of the Camp suggested the possibility of obtaining volunteer workers for the Camp as a solution to the proper feeding and cleaning of any animals.

For these three projects six members of the Department of Public Instruction were used; two of our natural scientists being assigned to each of the three projects. Much of the preliminary work was done at the Museum during the spring months. As the weather became warmer, frequent trips were made to Spring Valley to carry on the work. The most which it was hoped could be accomplished the first summer was an initial attack on the various projects.

One week before the arrival of the campers, the Museum personnel met the counselors employed by the Camp and explained some of the purposes of the program. They showed great interest in the work which was being done, and were very eager to help.

As the summer progressed, the three programs undertaken reached various stages of completion. For the identification of the trees, a thin copper metal was used so that the Braille could be raised. This sheet was then laid over a wooden frame and attached to the tree. Only a few of the trees were provided with such labels this first year. Work progressed slowly because it was necessary for the Museum personnel involved to learn the rudiments of Braille.

Before the pavilion for the museum could be used, new flooring had to be constructed, bushes that had overgrown the area removed, and

tables installed for the exhibits. This was done by the Camp staff. Even with a late start, a large collection of material was exhibited and labelled in Braille. Here the blind could feel the textures of stones in the local region, could handle the skeletal forms of different species of turtles and learn their identity by the shape. The blind were especially interested in feeling the claws and beaks of the bird specimens to learn more about their feeding habits and methods of getting prey. There were birds' nests to examine and mud houses of the wasps to feel. An electrical guessing game for the identification of stones was also installed.

The Nature Trail area was cleared of poison ivy by the county Department of Highways, and our two Museum workers cut a trail along the edge of the lake, with the hope of extending it farther in another year. Since this trail would be interpreted to the blind by the counselors, only numbers were placed next to the trees, shrubs and plants. These numbers corresponded with those on a mimeographed sheet. Here was detailed data on each of the trees marked. These were aids to help the Camp counselors identify the plants and then in turn interpret this information to the blind either by touch, taste or smell. The blind found the trail a delight and even enjoyed it occasionally during evening walks when one of the counselors would aid them on the way.

Another summer's work at the Camp will see the addition of new materials for the Nature Museum, more trees identified in Braille, and an extension of the Nature Trail. Those of the Museum staff who have been working with the blind feel there is not only personal gratification in aiding these handicapped people, but also that they are extending the services the Museum can offer far beyond the confinement of "museum walls."

The Role of the Zoological Curator as a Writer (With Some Impertinent Digressions)

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Few scientists have real literary talent. There aren't many Hans Zinssers, Archie Carrs, or Rachel Carsons in the twentieth century, and there weren't many Thomas Henry Huxleys in the nineteenth. But in most branches of science there have always been men of outstanding ability who could write clearly, accurately, and effectively. Curators, at least in proportion to their numbers, have contributed a fair share to such writing.

In my examination of the role of the museum curator as an author, I shall deal largely with his work as a synthesizer or as an interpreter of the data of science. I shan't be particularly concerned whether his writing is addressed to the scientist or to readers among other segments of the population. I would include the treatises aimed at zoologists in general, textbooks written for the student, even popular books dealing with travel, exploration, or reminiscences, if they in some measure reveal the objectives of science or the application of scientific methods.

I shall still have to reduce the menu further because of my own limitations. At best, the fare will be too herpetological for many tastes, and what a better-informed or less misanthropic author would have included as the *pièce de résistance* I am forced to leave to those more talented hosts, the anthropological curators. As egocentric creatures, perhaps more of us are interested in man than in any other species of animal. While I know in a vague sort of way what is going on in the field of anthropology, I fear that it's just enough to realize that I'm not qualified to assess the impor-

tance of the anthropological curator as an interpreter of his branch of zoology.

I do not follow the dictionary definition of a curator as being merely a custodian of a collection, not because "custodian" is losing its original connotations to become a flossy term for a janitor, but because the care of a collection is a minor part of a curator's duties. For, if he's worth his salt, the curator is not only the keeper (a more forthright, if misleading and inadequate term, still in use at the British Museum) of a collection, but a scientist who employs the specimens on his shelves as one means of gaining an understanding of biological principles or the processes of nature. The narrowness of the dictionary definition becomes more apparent if it be recalled that curators often become professors, and vice versa. There are many curators who hold dual positions, teaching part of their time in universities or colleges, and also carrying on their research at museums.

Nor would I insist that they be salaried members of museum staffs, for some are curators as an avocation. Dr. L. M. Klauber, an engineer by profession and for many years the top administrator of a large corporation, has written the outstanding herpetological treatise of the age, an exhaustive two-volume work, "Rattlesnakes, Their Habits, Life Histories and Influence on Mankind." Klauber's brilliant and voluminous contributions to herpetology leave no doubt concerning his qualification as a curator, a title he holds in two institutions.

In some instances, dentists or doctors have abandoned their practices to take up museum work. Dr. Malcolm A. Smith, once a physician attached to the Court of Siam, retired from medicine to work on herpetology at the British Museum (Natural History). As one of the better systematists, he has combined his museum work with field observations and studies of the relationships between structure and function. Offhand, I do not know whether he has ever held the title of curator (at the British Museum it would have been Keeper), but surely he has what might be called the better attributes of one. His books on Asiatic and British amphibians and reptiles have set high standards.

Temporary or permanent affiliations with universities further complicate the picture—curators rarely restrict their research activities to museums. "Systematics and the Origin of Species," a book that did much to stimulate thought as well as activity in museum circles, was written by Ernst Mayr while he was a museum curator, although the book was based on lectures delivered at Columbia University. Or I could point to such works as the invaluable "Osteology of the Reptiles," written by Alfred S. Romer, the Director of the Museum of Comparative Zoology. Technically, such authors as Romer are not curators; indeed, early in their careers they may

have been professors or students in fields that do not require collections. But aside from their greater administrative loads, the writing and research activities of such museum directors are essentially those of the curators. Similarly, custodians of live animals, properly enough designated as curators in many zoological gardens, also make their contributions as scientific writers.

So, in discussing the role of the keeper of collections as an author, I shall use the term curator in a sort of functional sense; I shan't be concerned whether the author in question is or has been called a curator, a keeper, or a director, or whether he began his career as a professor or as a custodian in the janitorial sense. There is no "typical curator." At best, I'm going to deal with an assortment of hybrids and intergrades who fail to fit the diagnosis for the species, one for which no type specimen could ever be designated. Fortunately, this gives me some leeway, with grounds for my contention that the dictionary definition has no status under the International Rules of Zoological Nomenclature.

II

Just what have curators produced that might be called important books? I've mentioned the notable contributions of Klauber, Mayr, Smith and Romer, each of whom has provided a critical synthesis of widely scattered information in some particular field. Klauber's book, for example, encompasses everything that is scientifically known about rattlesnakes. The two large volumes contain a critical, meticulous summary of an almost unbelievable amount of information derived in part from nearly 3,500 sources cited in the bibliography. Of even more importance, the conclusions reached by Klauber as the result of three decades of his research with rattlesnakes are fitted into the picture that emerges from his survey. The index to this formidable fund of information is so thoughtfully prepared that anything in the two volumes can be found in short order.

The ready availability of virtually everything that Klauber and others have managed to find out about the most widely distributed group of venomous snakes in the western hemisphere represents untold savings in the time of countless herpetologists, ethnologists, immunologists, physiologists, zoogeographers, ecologists, and paleontologists, to mention only a few of the specialists who will inevitably consult Klauber's treatise. It will also be read by a good many laymen for reasons ranging from the simple, legitimate desire to know something about an extraordinary group of animals to the practical, the peculiar, or the pecuniary (Who knows when he's going to find himself on a TV quiz program? The knowledge that rattlers are equipped with infra-red sense organs may be worth $64,000!).

This work on rattlesnakes is not addressed to the public except in the

sense of its being a sort of encyclopedic account, a compendium in a sense, but one that outranks the best encyclopedias. Klauber's skillful avoidance of the more esoteric terms and his ingenious elucidation of topics dealt with by previous authors in complex technical styles, mean that any educated person will find it both readable and comprehensible. There has been a growing tendency for textbooks to be written along similar lines. Many of us who, as college freshmen, struggled with Wilder's erudite but highly technical "History of the Human Body" (with its overuse of "the former" and "the latter" to the extent that Wilder himself occasionally became confused) would have felt that we'd been reprieved had we been able to switch to Romer's lucid and readable "Man and the Vertebrates."

Many high school students of my day who drifted into fields far removed from zoology, might well have been steered into paleontology if we'd gotten hold of E. H. Colbert's "Dinosaur Book," or later, as undergraduates, if we'd had his more advanced "Evolution of the Vertebrates." Both of these books successfully interpret anatomy and the facts of paleontology with a minimum of technical terms. I shan't maintain that only a museum curator could have prepared them, but I'd say that the odds were in favor of the curator's doing a better job than someone whose academic work had been restricted to teaching.

It's improbable, of course, that anyone writing on dinosaurs could have escaped dealing with collections. For the crushed skulls partly imbedded in the matrix, the improbable-looking fragments of bone, or the chunks of rock containing blobs or blotches that Hermann Rorschach might have put to good use, are to the paleontologist what *Drosophila* has been to the geneticist. The study, as well as the teaching, of paleontology and several other branches of zoology is inseparable from collections. The need for collections is reflected in the maintenance by the major universities of museums commonly staffed with professors serving part time as curators.

As might be expected, these part time university curators, like their museum colleagues who may or may not teach, usually write on topics that fall within the province of museum activities. These vary somewhat from one institution to the next, but few of the larger, not to say more enlightened, museums restrict their work to systematics. However, the preparation of handbooks for the identification of various groups of animals has been a conventional and altogether proper pursuit of curators. P. E. P. Deraniyagala, the Director of the Colombo Museum in Ceylon, assumed the roles of both curator and artist when he prepared a series of atlases that describe and depict in full color the vertebrates of his country. Curators or directors of museums in virtually all countries with the wealth necessary to support such institutions have prepared handbooks of one

sort or another. It would be instructive, but also tedious, to list the handbooks that curators have turned out, even were the list restricted to those dealing with vertebrates.

Data from collections of animals and plants, both fossil and recent, supplemented and interpreted in the light of modern genetics, have been the cornerstone of evolutionary theory. This, in turn, has been the guiding principle in most systematic work, despite the worries of a few taxonomists with fundamentalist religious views. They reject the idea of "detecting evolution at work," as Julian Huxley phrased it, and it must be admitted that evolutionary theory probably contributes more to our understanding of systematics than systematics contributes to the theory. Paleontologists, with their broader view of changes in animals and their environments that took place in time as well as in space, are better able in some respects to apply the theory in ways that reflect its validity.

It is not astonishing that a paleontological curator has done so. Two of the more important recent contributions to evolutionary theory have stemmed from a particularly talented author, George Gaylord Simpson. His books, "Tempo and Mode in Evolution," and "The Meaning of Evolution," reflect a most amazing grasp of the data and theories of genetics, ecology, and divers other fields. The ideas from these fields are brought into focus and interpreted in the light of paleontological information. The role of the curator as a writer has in this instance been that of a synthesizer as well as an interpreter of his particular field of science.

Simpson and Theodosius Dobzhansky, whom I regret that we cannot claim as a curator (the time may come when museums will have departments of genetics; perhaps we'll have curators of chromosome collections), were among the leaders who stemmed the tide of overspecialization, the compartmentalization of knowledge that led to the overworked wisecrack that philosophers went to the other extreme, but the scientist was a man who learned more and more about less and less until he knew everything about nothing. Bertrand Russell puts it more succinctly and with greater validity when he says "science is what you know, philosophy is what you don't know." Could Russell's statement be taken literally, perhaps many of us would be better qualified in philosophy than we are in science. A few dogmatic taxonomists, however, would better be classified with Carl Sandburg's Minnesota Swede who said, "maybe I don't know so much but what I do know I know to beat hell."

III

But not all curators bury their noses in taxonomic studies of some group of animals, studying their mummified carcasses or the near-mummified literature to come up for air sporadically and shout "Eureka! I've found

another homonym!" For at least one, G. Kingsley Noble, a mediocre taxonomist who probably found straight descriptive work boring, switched to field studies that were soon supplemented with laboratory experiments. His "Biology of the Amphibia," published in 1931, recently has been reprinted as the best available general survey of this group of animals. It was Noble who talked the American Museum into extending its sphere to include a Department of Experimental Biology, which after Noble's death became the Department of Animal Behavior with Frank A. Beach as chairman and curator.

Beach's important book, "Hormones and Behavior," a survey of the relationships between endocrine secretions and the things that animals do, appeared after he had joined the faculty at Yale, but it was prepared while Beach was a curator, and inspired in part by his museum work. Research dealing with live animals now supplements the work on dead specimens, and no longer seems extraneous to the museum program. The late Frank E. Lutz, for many years Curator of Insects at The American Museum of Natural History, took pride in the fact that he had never described a new species. He was more of an experimentalist who devoted little time to systematics. His much broader interests are reflected in his popular but provocative book, "A Lot of Insects; Entomology in a Suburban Garden."

The realization that physiology, animal behavior, and ecology are all intimately related to morphology, and hence also to speciation, zoogeography, and systematics, led to considerable doubt whether museums should restrict their work to straight systematics. The pigeonholing taxonomist is rapidly becoming as out of place in the field of museum work as the Gatling gun is in the field of battle, even though both were useful in their time.

It was perhaps inevitable that many curators joined the trend away from overspecialization, going beyond the descriptive phases of zoology to deal with functions and hypotheses, if not with principles and theory, as exemplified in most of the books mentioned above. The search for new species and the classification of animals, at least of those with backbones, may both be reaching stages of diminishing returns. This is not so true of the invertebrates or of the fishes and amphibians as it may be of the reptiles, birds, and mammals. I do not wish to imply that there is nothing left to be done. Enticing problems remain to be solved in every major group. Among the vertebrates there is scarcely an existing classification that cannot be improved, particularly as anatomical discoveries or the labors of the fossil hunter bridge some of the gaps or bring to light new or better material. There is no foreseeable end to what the paleontologist will pry from the earth's outer layers.

Even without modifications in viewpoint or interpretation that will rest on the acquisition of new fossils, new information, or new techniques for investigating relationships, systematists will be fussing over the arrangement of the higher categories until doomsday. The arduous studies of the more meticulous workers will reveal honest needs for improving classifications. But taxonomy has its moronic mountebanks who entertain the illusion that they are making a contribution to science by simply reshuffling the hierarchical status of groups, without bothering to provide either new data, new arguments, or a novel approach.

What is even more satisfying to the systematist who can't get on with his own research is the preparation of an elaborate critique of what some other worker has done. This consists of a listing of trivial mistakes, if possible annotated to leave the impression that this is only a sampling of the errors the work actually contains. It's a sly way of insinuating that the major findings should be accepted with skepticism. The intention of the author of the critique is much the same as that of the politician who calls the arguments of the other candidate an "harangue," aptly defined by Ambrose Bierce as "a speech by an opponent, who is known as an harangue-outang." Equally bad, the polemics in a critique may lead a few readers to infer that it is solely a matter of its author's letting off steam, a fatuous manifestation of his own frustrations. Valid criticisms that may have been offered are likely to be overlooked or discounted.

I do not wish to convey the impression that curators should shy away from disagreement. Conflict in viewpoint can be stimulating, if only because authors with opposing views prod each other into digging out additional data or into reappraisals or better interpretations of data presented earlier. Errors in fact or assumption that have appeared in print are legitimately pointed out, as they commonly are in any critical or comprehensive analysis of a subject, exemplified by such works as the recently reprinted "Adaptive Coloration in Animals," written just prior to the outbreak of World War II by Hugh B. Cott.

This eminent field naturalist, Strickland Curator at Cambridge University, brought together and analyzed enormous quantities of data from the field, museum, and laboratory, applying physical and psychological principles to demonstrate conclusively that cryptic, warning, and mimetic coloration in animals do indeed confer considerable selective advantage on their possessors in their struggle for existence. The practical value of Cott's researches became apparent almost immediately, for he served in the British Army as a camouflage expert, where he demonstrated the importance of cryptic and mimetic coloration in the human struggle for existence.

Cott's book is in "one of the great traditions of British biology," wrote

Julian Huxley, (and, I would add, of the traditions of the better scientific works penned by museum curators), in that it fills "the tradition of scientific natural history, in which the comparative treatment of patiently accumulated data is made to yield generalizations of first-class importance."

IV

A sufficient number of examples have been cited to show that curators are not, like the cobbler to his last, bound to their collections or to their systematics. Philip J. Darlington, Curator of Insects at Harvard's Museum of Comparative Zoology, scarcely mentions either insects or his beetle collections in a recent book, "Zoogeography," based largely on the distribution of vertebrates. Cherished by his colleagues as a source of friendly counsel, and as a herpetologist and editor as well, the late Karl P. Schmidt, while Curator of Reptiles, and later Head Curator of Zoology at the Chicago Natural History Museum, was one of the co-authors of "Ecological Animal Geography," and the even more welcome "Principles of Animal Ecology."

The invertebrates, to a large extent neglected by workers as well as by museums in recent years, have not been dealt with on a comprehensive scale by many curators. The most recent effort to produce a definitive work is that of Libbie H. Hyman, who, as a Research Associate (a sort of euphemism for a curator *sans* salary, but with a status having compensating advantages) at The American Museum of Natural History, has already prepared four large volumes universally recognized by zoologists who know them as the outstanding contributions to our knowledge of the anatomy and general biology of the lower invertebrates.

The publications of curators I have cited include those of divers specialists in fossil and recent groups. The sample is so small and so inadequate, however, that I'd have to use an *N*-1 formula to deal with it statistically, were this either feasible or desirable. Nevertheless, the books mentioned, while not wholly representative, serve to exemplify the diversity, if not the full significance, of the works that curators have written or assisted in writing, usually while continuing their own specialized research. These publications are not mere compilations. True enough, many of these authors combed the literature in their own as well as distant fields, often digging out important facts from obscure sources. But in every instance the author has corrected, arranged, correlated, and integrated—in short, interpreted and disseminated vast, sometimes almost unbelievable quantities of data or information. Whether written for the student, the specialist, or the intelligent layman with an avid curiosity but no pretensions to being a scientist, these books have advanced the frontiers of knowledge in one way or another.

Appeal to a broader audience may not directly accelerate the advance of science. But indirectly it most certainly does. Widespread understanding of the problems, the objectives, and particularly of the methods of science, is now of utmost importance in gaining the support of the public, on whom science is increasingly dependent for support. Developments in recent years have done much to dispel the notion that scientists are a group of cloistered egg-heads.

It was not many years ago that a senator or congressman could (and did, I am told) regale his constituents with the "shocking" report that the government was wasting their money to support a study of "the sex life of the frog," when he discovered that researches dealing with amphibian life histories were being sponsored by the Bureau of Fisheries. At present time there are at least a few politicians sufficiently well-informed to appreciate the fact that such research could lead to the medically important use of frogs in pregnancy tests on the one hand, and to the expansion of the profitable frog-leg industry on the other.

In an era when we are beginning to entertain fears concerning the depletion of our natural resources, the curator, as a writer of popular books, has assumed a new and important role as a conservationist as well as an exponent of scientific methods in dealing with these problems. "That Vanishing Eden: A Naturalist's Florida," an informal, chatty account of a biologically interesting portion of the United States, was written by the late Thomas Barbour, Curator and later Director of the Museum of Comparative Zoology at Harvard College. Barbour vigorously decries the destruction of swamplands by misguided army engineers who failed to foresee the frightful consequences of constructing drainage canals, the almost uncontrollable fires in the swamp muck, the invasion of wells by salt water from the ocean, and the destruction of habitats. Barbour's arguments should have convinced even the most hardened real estate operator that Florida's few remaining natural landscapes are of potentially greater value as tourist attractions than they will ever be if converted to the limited agricultural uses for which these lands are suited.

"A Naturalist in Cuba," and other books by Barbour, whose engaging, highly personal style reflects his love of the rare and the beautiful in nature perhaps more than his appreciation of scientific methods, must nevertheless have given many a reader some of the thrills experienced by those who knew "TB" and loved him. Barbour was justly famous on many counts, not the least of which were his feats of "disenjeezalization," defined by his outstanding student, E. R. Dunn, as the "reducing of a situation, a topic or a theory to order and common sense," an ability possessed by too few authors who attempt to interpret science for the masses—or, I might add, for their colleagues.

Barbour's efforts as an author were, to say the least, entertaining, and the readers of any of his four books must have enriched their understanding and hence their appreciation of man's relation to nature. The larger museums accept the fact that many visitors wander through their halls in search of entertainment rather than knowledge. There is no sound objection to entertainment as a legitimate function of museums, even though greater effort is being made to seduce the visitor into learning something of value while he is being entertained. This is usually the intent, but not necessarily the motivation, of the curator who writes a popular book.

v

George Gaylord Simpson's "Attending Marvels" is ostensibly little more than an entertaining and often humorous account of paleontological work carried out in South America. But the incautious reader finds himself acquiring an immense fund of reliable information concerning the fossil record, the circumstances that led to the evolution of whole groups of animals peculiar to South America, and what happened when avenues for the dispersal of land animals were re-established with North America. Before he knows what's going on, the reader is enthralled with the problems of the paleontologist. If he doesn't dash to the nearest museum seeking a position as fossil hunter, at least he gains a realization of the worthwhile nature of such work, and the need for supporting such investigations.

Somehow "Attending Marvels" never had the circulation it merited, possibly because it was published during the depression. I shall refrain from discussing the elements, some of them mystifying even to merchandising experts in the publishing houses, that enter into the commercial success of any book, but partly it's a matter of the author's acquiring a following. William Beebe, originally an ornithologist who later found marine biology and exploration of the ocean's depths irresistible, is a shining example of what an occasional curator can do in this respect. His literary talents, which became apparent early in a career at the Bronx Zoo, brought him both fame and a following. "Galapagos, World's End" made one small, virtually unknown (except for the few who had read Darwin's "Voyage of the Beagle") archipelago in the Pacific as well known in the hinterland as Staten Island is to New Yorkers. Later books, "The Arcturus Adventure" or "Nonsuch, Land of Water" and those that followed, had an audience that was preadapted, ready for whatever Beebe turned out.

Frank Chapman, another curator of birds, who wrote his "Camps and Cruises of an Ornithologist" half a century ago, went on to achieve a reputation as a writer with "My Tropical Air Castle," which described

the work he had done in Panama. Robert Cushman Murphy published "Bird Islands of Peru," his fascinating account of what offhand would sound like a prosaic subject—the guano industry. A decade later Murphy completed his more scientific than popular two-volume encyclopedic "Oceanic Birds of South America."

Curators in other parts of the world were producing works of a similar nature. Hans Gadow, Strickland Curator at Cambridge University, was the author of an important part of the ten-volume "Cambridge Natural History," out of date in many respects after half a century's use, but still consulted as a source eminently preferable to the relatively childish works of the sort published in the United States. Gadow, one of the better anatomists of his day, was also a field naturalist. The narrative of his travels in Mexico in 1902 and 1904, published fifty years ago, with the title "Through Southern Mexico," remains unsurpassed among the many books that have since attempted to give some account of the natural history of that country.

One of the few recent efforts to emulate the standards set by the "Cambridge Natural History" is a handsome 5,000-page work published in Italy. Its five weighty volumes, with the unpretentious title "Animali," cover the natural history of the vertebrates of the world, the fishes, amphibians, reptiles, birds, and mammals, a task the more remarkable for its having been achieved by one man, Giuseppi Scortecci, formerly a curator at the Museum of Natural History in Milan, but now the director of the Institute of Zoology at the University of Genoa.

South America, where careers in academic circles are all too often interrupted by political changes, has nonetheless supported museums, laboratories, and research. We can thank two curators, Angel Cabrera, of the La Plata Museum, and José Yepes, of the Buenos Aires Museum, for their handsomely illustrated "Mamíferos Sud-Americanos," the only reasonably comprehensive account of South American mammals in existence.

Considering the immensity of the task, it is astonishing that so few regions in the world lack some sort of work covering the backboned animals, though few works are so elaborate as that by Cabrera and Yepes. The handbooks for many areas are not complete, well illustrated, or thorough, and not all of them have been prepared by museum or zoo curators. Perhaps only the vertebrate faunas of the United States and portions of Europe have been covered with any approach to adequacy. In the United States, the worker in any area has a choice of at least two or three handbooks if he wants to identify a fish, amphibian, reptile, or mammal. The needs of the amateur ornithologist would appear to be surfeited, although the newer handbooks depicting many of the species in color have led specialists, as well as part-time bird watchers, to add a few

more volumes to their overflowing bookshelves.

Along with the quality of the research done in museums, the excellence of the handbooks has improved. Where their predecessors were often little more than glorified "keys," the new books often incorporate summaries of the biological attributes of the classes of animals covered. With identification no longer a problem in the United States, herpetologists have turned their attentions to the interrelationships of habits, behavior, and the environment of amphibians and reptiles. Clifford H. Pope pioneered in this sort of writing by herpetological curators in the United States with his "Snakes Alive and How They Live," a book still in demand after two decades of use. James A. Oliver's recently published "The Natural History of North American Amphibians and Reptiles" is an eminently good example of what the curator in the zoo can do when he is familiar with the technical literature, living animals, and the facets of his subject of greatest interest to the public. His book is essentially a popularized comparative biology of two groups of animals, with a style that is palatable to both the amateur and the specialist.

The increasing demand for authoritative books of the sort led Clifford Pope, an author of no mean ability, to abandon his career as a curator to devote his full time to writing. However, the increasing public interest in science, which still includes biology despite recent journalistic preoccupation with guided missiles, rockets, and Sputniks, has not produced a sufficiently large market for books dealing with natural history to tempt many curators to abandon their microscopes in favor of typewriters.

VI

For if scientists are underpaid, authors fare even worse in most instances. Were they to maintain a record of the hours spent checking references, selecting suitable illustrations, typing and correcting the manuscript, or in the numerous other time-consuming tasks that enter into the preparation of material for the publisher, many of them would discover that they were working for less than the wage designated as the legal minimum for the illiterate laborer. The publisher, perhaps with some justification, visualizes himself as the poor chap who takes all the risks. However, the author is completely at the mercy of his publisher when it comes to format and list price, or to the advertising and promotion of the sales of his book. If the publisher's decisions prove to be wrong or based on something that actually has little to do with the book, even one with considerable merit may wind up being remaindered, with no loss to the publisher and no profit to the author.

Where the bookdealer gets thirty to forty cents on the dollar for ordering the book and handing it to the customer, the author receives ten cents.

This leaves fifty cents or so that the publisher can use to defray the cost of the vacation in Palm Springs that he'll need after the nervous strain of splitting his half dollar with the printer (I know I'm wrong, but I visualize him as that fellow with a dirty apron, a strong union, and a Cadillac), the landlord, the advertising executive, and some odds and ends called editors and proofreaders. I suspect that a banker with palm extended is in this line-up some place, and it's certain that the Internal Revenue Service is there, too, with an even more spacious palm. The pusillanimous author, without whom the whole chain of events leading to the publication of a book could not have been set in motion, can do little but pocket his dime and go back to his cold-water flat—unless, of course, he has an institution to sustain him, to pay him a salary for his work between the hours of nine to five, with week ends off for good behavior.

His evenings and his week ends the curator can devote to popular writing. He should also devote some thought to his situation. While he is poring over alcoholic specimens, tabulating the activities of his experimental animals, or squinting at rocks through a microscope to see whether those blobs really *are* fossils, the professional science writers who deal with natural history have been perfecting and polishing their literary styles. If the curator is going to write a book with sufficient appeal to warrant the expenditure of most of his free time, he'll have to produce one comparable to those of such old hands in the game as Edwin Way Teale ("Autumn Across America") or Joseph Wood Krutch, former professor of dramatic literature, drama critic, essayist, and biographer, who has turned his philosophic mind and a skillful pen to the preparation of such books as "The Desert Year," "The Voice of the Desert," and "The Great Chain of Life."

The curator with literary ambitions may well ponder the problem of whether he can more profitably spend his time writing for his colleagues or for the public. If his salary is inadequate to enable him to send his children to college, the few extra dollars he can make from a popular book may be tempting. If he believes that a book might enhance his prestige or provide him with a larger audience than the few hundred specialists who normally read his papers, he may consider it worth the risk. Only a psychiatrist would pretend to fathom an author's motivations and those of curators are probably more varied and complex than the average. Pecuniary motives rarely, if ever, enter into the preparation of a scientific treatise. But when the curator prepares a textbook or a popular book he expects to be paid for it—and he has no strenuous objections to royalties from his treatise if the publisher makes any profit from it. I do not know of any curator's having patronized the vanity press. I do not know one who could afford to.

VII

Some curators have no desire to write popular books. I know one who early in his career wrote a first-rate book that he now regards as a youthful indiscretion. It was not so many years ago that many scientists looked upon popular writing with that disdain with which a debutante regards last year's gown. I doubt whether the popularization of science is now frowned upon by anyone as long as it is accurate. In fact, most scientists have recognized that "sound public information about science is integral to science itself," as Gerard Piel stated in a recent article in *Science* magazine. According to Piel, some scientists have accepted the notion of collaboration with professional science writers. This might well be the ideal solution to the problems that indubitably confront the editors of such periodicals as *Scientific American* or *Natural History* in their efforts to obtain sound, readable summaries of scientific subjects. Collaboration with the competent science writer might also be a godsend to the curator plagued by demands on his time that range from serving on committees to settling barroom arguments, or appearing on TV programs, or having his ear bent on the telephone by *Time, Life, The New Yorker,* or kids with sick turtles. Curators will recall one pest, a columnist, who employed telegrams to ask questions, and expected his reply in the same medium.

Happily, there are a few curators who still manage to find time to write. A few are so busy turning out reports of their investigations that they can't take time to read those written by their colleagues, much less attempt to interpret their work for the masses. But others, the gifted minority, not only get their applications for grants drawn up, their research done, and their reports written, but still find time to write a popular book or so on the side.

Offhand, I can think of only one man who manages to do all these things—Archie Carr. Between sojourns in the Caribbean region and trips to other portions of the globe within the tropics, he serves as a university professor, and maintains active affiliations with two museums. An outstanding authority on turtles, his handbook dealing with those in the United States was so well done and so readable that he was awarded the Elliott Medal for the work. "The Windward Road" won him the John Burroughs Medal in 1957.

A field naturalist at heart, a biologist by training, a herpetologist by definition, and a teacher by choice, Archie Carr is spoken of by Earl P. Hanson as having "a poet's sensitivity toward man as well as toward nature." Carr is not adequately described merely as being talented. He is supremely gifted.

Carr's extraordinary flair for the unusual juxtaposition of words that are both meaningful and graceful, as well as imaginative and often humorous,

sets him apart from his fellow scientists. "The Windward Road" reads like a novel, with a faultless prose that no other biologist can match. Yet in this book Carr manages to weave a rather complete account of the research he has carried out with marine turtles, creatures of obscure origins and an uncertain future.

At least their futures seemed uncertain when Archie Carr undertook the task of getting precise information concerning their ecology, their movements, their reproductive habits, and their life histories. The depredations of man, with his commercial exploitation of turtle eggs or turtle flesh, have resulted in the decimation of the marine species. With the reliable information that Carr is assembling, it now seems possible that group action by the governments concerned with their utilization can save the turtle industry, building "unity and strength in the Caribbean by raising the yield of the sea to the people around it."

I can think of no better example to illustrate the value of good writing as a means of conveying to the public some notion of scientific methods, or the planning, the reasoning, and the work that lead to biological investigations. In this instance, so rarely the case, the various objectives of the investigation, its utility, and its benefits to mankind are foreseeable. But, quoting again from Gerard Piel: "If the public is to support the advance of science for motives other than utility, then people must be able to share not only the useful, but also the illuminating and the beautiful that come out of the work of science."

The role of the curator as a writer therefore need not be, should not be, restricted to the assemblage and analysis of data. The preparation of textbooks, or weighty tomes, the lucubrations of curators that serve the useful function of assembling, synthesizing, interpreting—making usable tremendous accumulations of information—are extremely important aspects of the curator's work. He can be expected to do his best to extract generalizations, advance hypotheses, or develop theories as a result of his efforts.

Perhaps the professional science writer can take over at this point. But should he? A curator need not store away his ideas and the results of his research in the pages of technical journals. He needs the support that can come only through an understanding and an appreciation of his work. Just as he presents parts of his collection to the public in the form of illustrative and attractive exhibits, so must he keep the public informed by means of more readily comprehensible and more widely disseminated accounts of his work.

"To jog the understanding is a greater feat than to jog the memory, for it takes more to make a man think than to make him remember." So wrote the Spanish philosopher Baltasar Gracían in the seventeenth century.

However obscure the idea may have become as re-stated in the fashionably recondite terms of pedagogical pinheads fancying themselves to be protegés of John Dewey, it is still valid. The words of Gracían epitomize the basic, if not altogether altruistic, aims of the curator as a writer.

Making a Model of Mycetozoa (Slime Molds)

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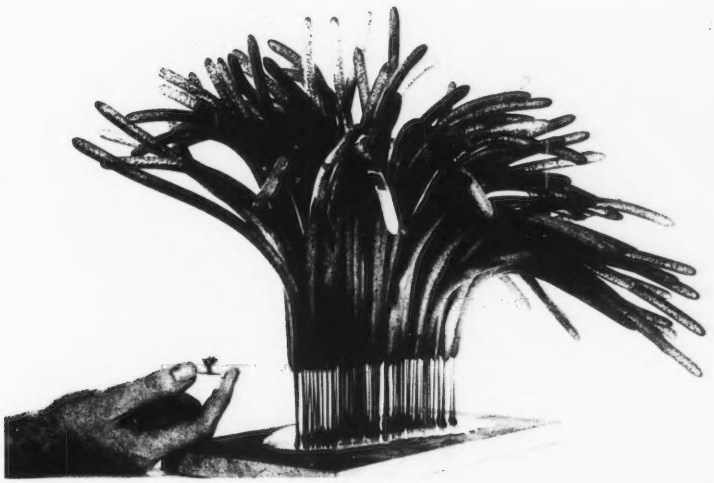
In planning the new Hall of North American Forests at The American Museum of Natural History, it was decided to include an exhibit of life of the forest floor, since most biological activity in the forest is found in the upper two inches of litter and soil. The blown-up scale exhibit contains everything from eight-foot oak leaves to a four-foot millepede, predatory mites, fly larvae, and a host of other reconstructed species, all enlarged twenty-four times. This paper, however, will deal only with the making of a model of *Mycetozoa* (slime mold).

There are hundreds of species of slime molds, but for this exhibit one of the commonest (*Stemonitis*) was chosen. A good magnifying glass is required to see the finer details of these beautiful, small, primitive plants. The actual *Stemonitis* are about ¾″ to 1″ high. To make a model that would fit the established scale of enlargement by twenty-four times, which enables the museum visitor to see most of the finer details of otherwise microscopic organisms, our model of *Stemonitis* had to be made about fifteen inches high.

The photograph shows that this species of slime molds is similar in appearance to the common cat-tail. To make the spike (sporangia), about one hundred ⅜″ plastic (acrylic) rods 12″ long were cut, rounded off, and polished on both ends. A hole approximately ½″ deep was drilled in one end, and a 4″ length of 16-gauge iron wire was inserted. The wire was then cut to exactly 3″ in length. To simulate the spike, which looks like a loose, gauzy labyrinth of fine black thread under the fuzzy brown surface of the mold, a fine dental burr in a flexible shaft was used and all the surface was lightly and irregularly etched from the top down

about two-thirds of the length of the plastic rod. About fifteen rods at a time were then heated in an oven of 150° until they were limp. The rod that would have the maximum bend was shaped, following the curve of the actual specimen, and a minute or so was allowed for it to set. The other rods were then bent until all were shaped, so that when they were in place they would make a natural clump or group. The high shine on the rods was removed with fine steel wool. Next, with a damp rag dipped in black casein paint, the surface was wiped over, filling in the etched lines. Each piece was left to stand a few minutes before the entire surface was lightly wiped, allowing the paint to stay in the grooves, which then contrasted with the clear plastic. Next, one coat of satin varnish was applied and immediately dusted with one heavy coat of fine brown cotton flock. The excess was then shaken off and let dry. The soft, dusty, brown spores that cover the *Stemonitis* (represented in the model with the cotton flock) start dropping off from the top, revealing the intricate, gauzy thread-like structure underneath. In order to simulate this stage, the flock was brushed off from the top down for from 1″ to 5″ so there would be a gradual blending from a bare tip to the fully flocked surface. A fine wire brush was used for this part of the job.

To make the cone shape at the base of the slender wire stem, a few holes were drilled in a small block of plaster. A cone shape 3/16″ wide was reamed and a wire was inserted in each. Then the cone around the wire was filled with hot beeswax. The small cones were then slid off the



wire they were cast on, and placed ½″ up on the wire stem attached to the plastic rod. The stem and cone were painted deep red—almost black—following the actual coloring of the live specimen.

The plastic rods (sporangia) were mounted so close together that they actually touched each other, following the original pattern of the real specimen. A paper template was made so that the rods could be placed accurately on the finished base.

The finished base was a piece of white pine about 8″ x 12″, textured and painted with casein paint to simulate the surface of old bark or wood. The paper pattern was then laid on the base and an outline drawn around it to represent the slime. The slime was made from Selectron #5026, a clear liquid plastic (any cold-setting plastic could have been used), to which a slight amount of white and silver lacquer base pigment had been added. The plastic was poured on the base to form the slime outline desired, then allowed to set and harden. When the "slime" was hard, the paper pattern was placed over it, ½″ deep holes for the wire stems were drilled, and the sporangia were placed in position to form a natural patch.

The steps described in this paper illustrate primarily the careful use of synthetic materials to simulate living matter. A careful analysis of the basic structure of the object to be reproduced predetermined what materials were to be used. This basic approach can be used whenever any biological models are to be made for exhibition or teaching purposes.

Museum "Co-Ops"

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When a Renoir, recently offered for sale at the Parke-Bernet Galleries, went for $200,000, even the most conservative individual was forced to admit that the cost of fine art has become prohibitive except for the most wealthy museums. The price of good art, whether it be for modern masters of all nationalities, for first-class examples of native primitive art, for top-quality finds from recent excavations, or just for fine furniture, has become increasingly beyond the reach of museums not too heavily endowed.

Yet, one Renoir shown in Suburbia is more important in the development of that community than all the Renoirs in all the big New York galleries and museums put together.

If you pin-pointed the frequency of museums on a map of the United States and Canada, you would find clumps of pins around the larger cities, fewer pins at the location of the smaller cities, and very few pins in the less heavily populated states. In New York City, the Borough of Manhattan is heavily saturated with museums or museum-like institutions. The neighboring boroughs of the Bronx and Queens are suffering from what might be called "institutional anemia." Brooklyn is fortunate in possessing the large Brooklyn Museum, which for many years has had a definite cultural effect on the people who live near it.

Similar museums in places such as Levittown, for example, would also benefit their respective communities. In fact, every large community in the United States and Canada—even every large shopping center where people gather in the market place should have its own museum.

It is important to note in this respect that, at our guess, 80 per cent of the American people never, or very rarely, leave their birthplace or home town community. To show all aspects of art in all small communities, although on a small scale, is a project one of the large educational founda-

tions might well consider seriously.

But with inflated prices, and the undeniable fact that time or variables in taste add more and more worth to objects of art, private owners and museums alike are less and less willing to send their paintings and art objects out on loan exhibitions. The newer and poorer museums and the potential museums cannot afford to buy. They cannot borrow. What to do?

The solution is simple, and was first instituted in Europe a long time ago. Museums must form a buying association, with one specialist assigned to each of the different fields of art. The member, or "co-op," museums should not strive to accumulate large collections. Rather, they should buy one or two or ten first-class pieces, according to their money-raising abilities, and the purchases would then become their own. At the same time, these acquisitions would be grouped with the purchases of the other member museums and made available for traveling exhibitions. Plans might even be developed to allow some of these exhibitions to stay for several years in one community.

It would be best to restrict purchases of each member of the group at any given time to the same collecting field of art—say, modern art—so that the nucleus of a fine collection, unified in its significance, would be founded. Let's say that thirty museums took part in such a plan, and that each of the thirty bought one really good modern painting. This would mean that the museum buyers' group would have an excellent collection of thirty modern paintings available. Thus, each community in which a member museum was located would have the opportunity to benefit from a local showing of the collection. One technical assistant to install the show and one secretary to take care of the necessary clerical duties would be all the personnel required. Volunteers, possibly from local service organizations such as the Junior League, would give of their time to safeguard paintings during visiting hours.

This cooperative buying plan could even give rise to new museums. Such museums could be small, but exquisitely planned for the exhibition of collections jointly owned by the museum buyers' group. The plan would make it possible for communities, now far removed from good museums, to have their own with the finest art available.

The technique of manufacturing fitted cases for traveling exhibits is well-established. One important function of the member museums would be to make such cases, to insure that the art objects would travel without harm. If the right directions were attached, even the least professional of museum assistants could properly pack and unpack the collections with a maximum of safety and speed.

Here, then, is the germ of an idea worthy of consideration by existing museums that lack the funds to purchase large collections of worthwhile

art objects, and by communities desiring museums of their own to enrich the lives of their residents.

To sum up, the necessary steps for such museums, and/or such communities, to join forces and resources are: to appoint the representatives who will put the plan into action; to provide the relatively small amount of money needed from each member; to buy the desired art objects; to schedule their showing. By so-doing, great art could be brought to hundreds of thousands of people to enjoy and study; to people who would benefit immeasurably from their relationship with masterpieces they otherwise might never see.

The Right To Do Research

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The leaders of our cultural institutions are wont to speak in noble terms of the duty of their organizations and of the public towards research. The sentiment is both natural and highly deserving of praise. It is deeply shared by the dedicated scientist driven by an inner sense of duty towards the increase of human knowledge. But does this commonly approved feeling of abstract obligations realistically express the basis on which individual scientists, through their positions, actually receive the main support for their efforts in pure research? I submit that the cases in which it does are extremely few, and will probably always so remain.

It is true that most people will be in favor of a noble obligation to do research, just as they will be against sin. But is this concept of research as an institutional and individual duty actually an aid or a handicap to the advancement of pure research in the millions of special cases which, in the aggregate, constitute the world of science and provide the sources of its growth?

To the extent that research is defined as a duty, the particular kind of research that is proposed and the urgency of the need for the knowledge it will produce, become the legitimate concern of administrators and budget authorities, who have to balance demands and needs against means. To argue convincingly about a duty and need to study the bats of New Guinea in New York, or the fleas of elephants in Boston is very hard indeed, however easy it may be to obtain applause for general statements about the necessity for more research.

The difficulties created by the duty concept of research in museums, universities and similar institutions do not merely haunt the administrators and fund raisers. There are also unfortunate repercussions upon

the status and privileges of the individual scientists. If research is conceived of as a duty, then it becomes part of the services for which the scientist is compensated by his salary and other material benefits. This, in turn, means that his research becomes subject to inquiry and direction by the administrators and boards that define the duties of the positions they create and maintain, and implicitly retain the right as well as the obligation to re-assign the tasks according to changing conditions and the best interests of their institutions.

If it were historically and sociologically true that most curatorships and professorships were, in fact, created because of a direct need of the institutions concerned to have the particular research problems pursued by their faculty members studied on their premises, it would, of course, be intellectually dishonest to suggest a different concept of the place of pure research in the institutional pattern. The burden of the evidence points overwhelmingly in the other direction.

When the records of most privately endowed museums, with a long enough history behind them, are examined it will undoubtedly be found that the first salaried staff appointments included no research scientist in a majority of the cases, including those with which I am most familiar. Only under the pressure of practical necessities, arising from the need to keep systematic order in growing collections and to insure the authenticity of an expanding exhibition program, did these museums gradually, and sometimes even reluctantly, embark upon the employment of research scientists. And, as long as the purely practical need remained unobscured by the concept of a noble obligation towards research as an ideal, the increase of scientific positions was rapid and encouraging. I am sure that more than one example could be brought forward to show how this growth tapered off, or was even brought to a standstill, when sordid necessity was later lost sight of in the glow of high principle.

In the universities it is the need to have a subject taught that leads directly to the creation of the vast majority of faculty positions. The situation is quite similar to that of the museums. The methods of the classroom and the exhibition hall may differ, but the professor and the curator are closely akin in their educational functions and purposes, and both find their places in response to the need for these functions.

The basic reason why colleges and museums seek research scientists for their faculty positions is not that these institutions have a particular need for the specific answer to the problems that the professor or curator pursues in his personal research. But for their educational activities and the proper care of their treasures, these institutions need at their disposal a command of the subjects they deal with, which only the scientist operating at the frontier of knowledge in his own research is likely

to acquire and to keep up to date. They also need in, and from, their educators the inspiration of the scientific spirit which makes it a personal necessity for the members of the faculty to participate in the search for new knowledge by their own activities and not merely by vicarious experience.

The institution's need for research, beyond the routine of caring for its treasures, would be impossible to prove from any purely practical considerations. Its needs for the qualities of research scientists is beyond dispute. If one could be obtained without the other, something could be said for trying to solve the problems of the budget in that manner. Whether our fiscal policy-makers like it or not, such a solution is simply a physical impossibility.

To obtain the human qualities and qualifications we need on museum and university faculties, it is not enough to offer an adequate remuneration in the coin of the realm. We must also offer time, opportunity and facilities to do the kind of research by which the faculty members can satisfy their own needs and maintain the qualifications we demand of them. The provisions we offer for personal research are simply the most economical means of obtaining the services we need for our educational functions and our custodianship of cultural treasures.

Crudely put in this manner, the statement is not particularly pleasing to the ears of a scientist. Nor is it to the writer. But we should not let our feelings conceal that it is true, and that it actually provides a far more effective weapon in the cause of pure and free research than can ever be found in noble sentiments of obligations toward science, without concrete foundations in the practical necessities of our cultural institutions.

Under this concept, the opportunity to do research becomes part of the compensation received by the faculty member, along with his salary, pensions and other benefits, for being what he is and rendering the services he does in other fields than his personal research. Research is not a duty of his position but his earned right as an individual.

The institution does have a right to insist that the faculty member actually uses the opportunity offered for research so as to maintain his qualifications for the duties of his position. It has no right to control or direct his personal search for new knowledge along lines of his own free choice.

The question of whether investigations of the bats of New Guinea should be provided for in New York evaporates completely from administrative and budgetary consideration. It is nobody's business, other than that of the scientist himself, in the exercise of his personal rights. All budgetary provisions are based upon the institution's purely practical

needs for his services in other functions. And, if there is a more economical way of obtaining what is needed, nobody has yet been able to point it out.

As it simplifies the institutional problems of fiscal policy at the governing level, so does the concept of research as a right, and not as a duty, also clarify and strengthen the individual scientist's position in relation to the institution. When the time allowed for research is time allotted for the exercise of a personal right, it cannot be subject to administrative reallocation to other tasks. An institution that so increases the duties of its faculty positions as to make research impossible unless it be at night or on "days of rest," will not merely be betraying an abstract ideal we would all like to serve when we can afford it. It will be violating personal rights, which is something far more difficult to get away with over the protests of the victims.

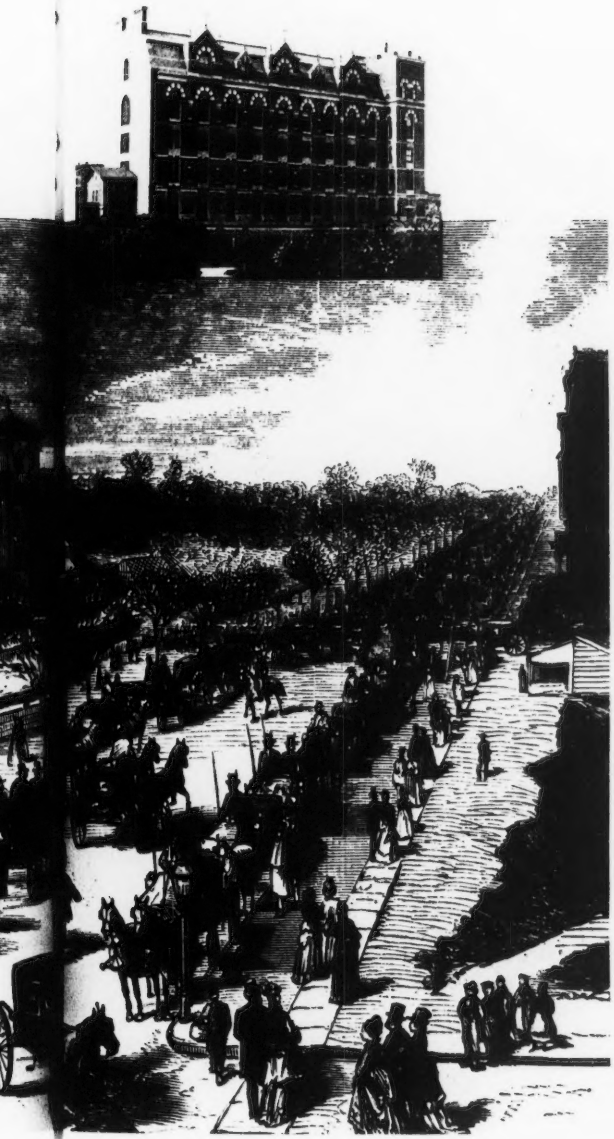
In the academic world of higher learning, including museums functioning at the university level, it will generally be found that approximately half of the total time within regular hours must be allowed the faculty for free research by personal choice in order to secure and to keep a staff of adequate intellectual quality and sustained leadership. By the pattern in which an institution creates and offers a faculty position it irrevocably establishes minimum rights to do research, which can not in justice subsequently be reduced by unilateral action.

In a museum, half of the time for personal research cannot be interpreted as half of every day, nor even always as half of every year. A department may be faced with the task of a periodic revision of its exhibition halls, and the time for personal research may be substantially reduced, for even a couple of years. When the task is completed, there will follow a period of less demanding duties during which the institution can repay the time borrowed from the hours that were the curator's by his rights. But the institution that does not, in the long run, meet the requirement of half time for research in positions requiring the talents of scientists will also, in the long run, suffer thereby.

There may be institutions that do maintain positions for which they cannot point to a practical need in their educational program or other activities. More power and honor to them for their service to an ideal in which we all believe. For the rest of us it is a daily struggle to obtain the qualified services we require for purely practical reasons, and we will be stronger in our efforts for bluntly admitting the facts of the situation, without recourse to idealistic generalities that may apply in some future millennium, but have no bearing upon the problems of the state we are in today.

CURATOR

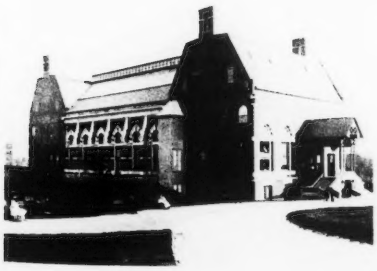
looks at museums . . . and not just the buildings of today. The imposing façades we take for granted did not spring up overnight, and the nuclei of New York's great collections were first housed in surroundings that can only be called modest. In the following pages we contrast some of these early buildings with their well-known counterparts of today.



While fashionable New York attended a reception at the Central Park Arsenal (left), which in 1875 housed the collection of The American Museum of Natural History, work was nearing completion on the first of the buildings that were later to be the Museum's permanent home (inset).

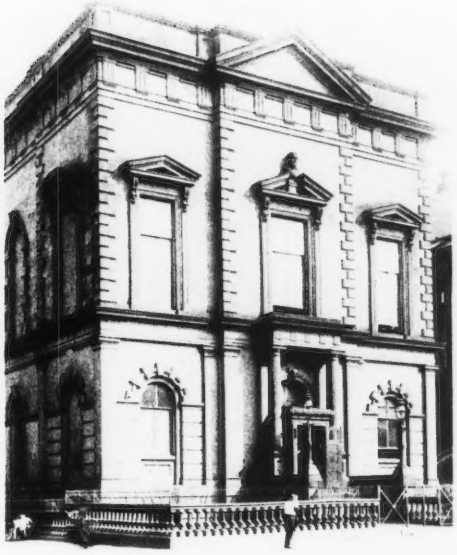
Below left is a photograph taken a few years later of the first permanent building of The Metropolitan Museum of Art. Now Wing A of the Museum, it was opened in 1880.

The oldest museum in New York—founded in November 1806—is The New-York Historical Society. Below is a watercolor of its first home, the City (Federal) Hall at the corner of Wall and Nassau Streets. The collections were housed here until 1809, when they were moved to Government House, at the foot of Bowling Green.

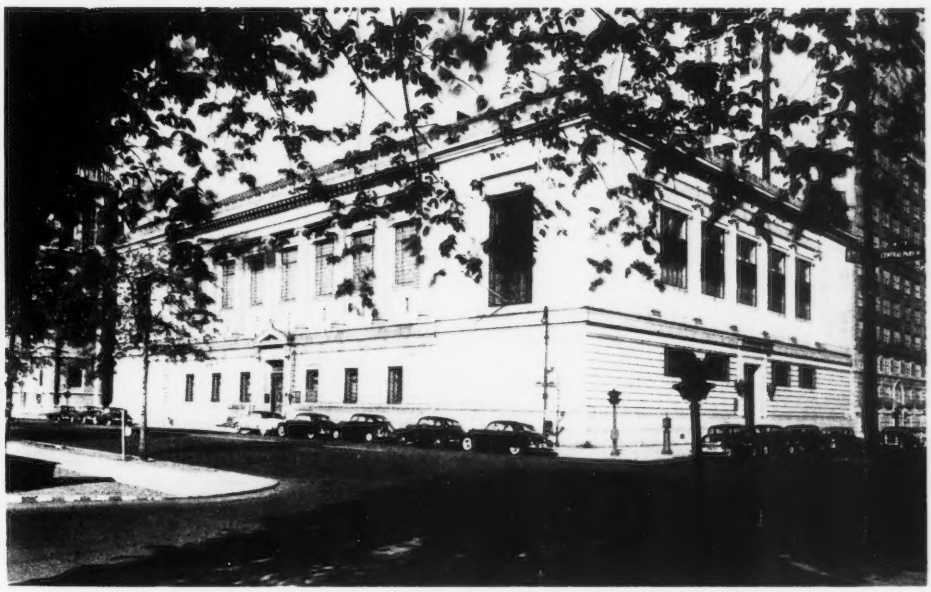


Photographs on page 75 courtesy of The New-York Historical Society and The Metropolitan Museum of Art; page 76, The American Museum of Natural History; page 77, The New-York Historical Society; pages 78-79, The Metropolitan Museum of Art; page 80, Museum of Modern Art and David E. Sherman, New York; page 81, Museum of the City of New York and Gottscho–Schleisner.

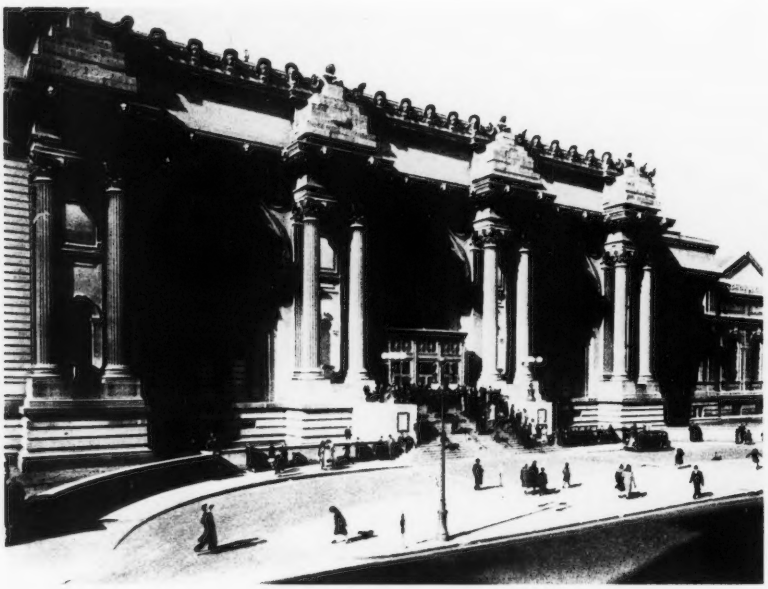
Although the first of the present buildings of The American Museum of Natural History (page 75) was opened in 1877, part of the collections remained in the Arsenal for some years. Above is a view of this building in the 1880's, contrasted, below, with the main Central Park West entrance of the Museum today.

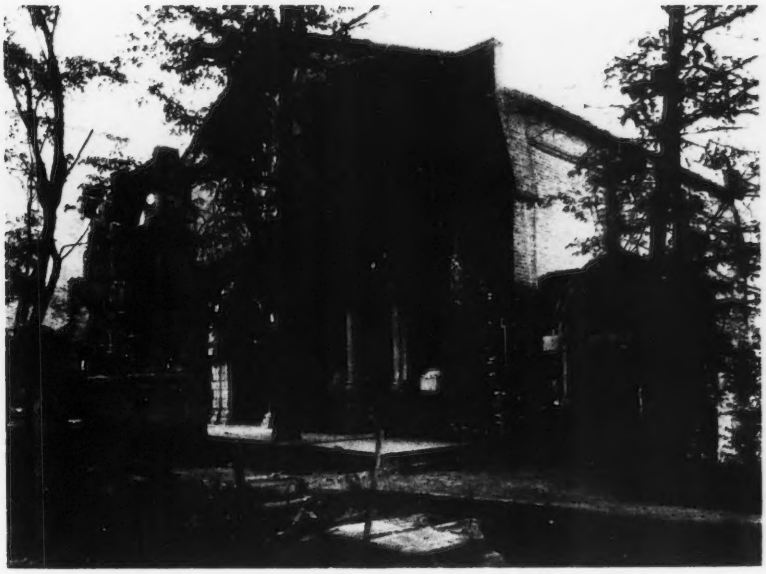


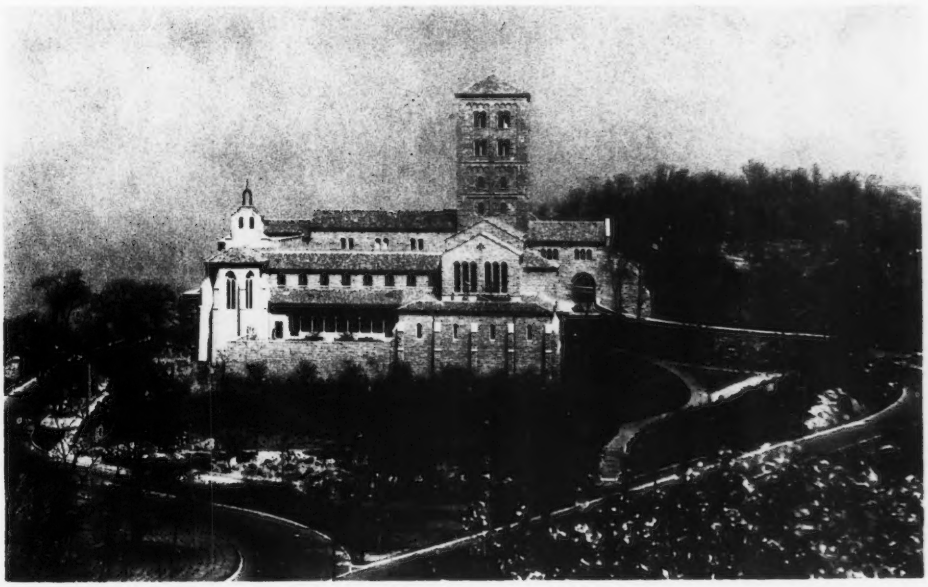
There were many moves in store for The New-York Historical Society after 1809. In 1857, however, it found in its seventh home on Second Avenue and 11th Street (above), a resting place for 51 years. Then, in 1908, the Society moved to its present quarters (below), on Central Park West and 76th Street.



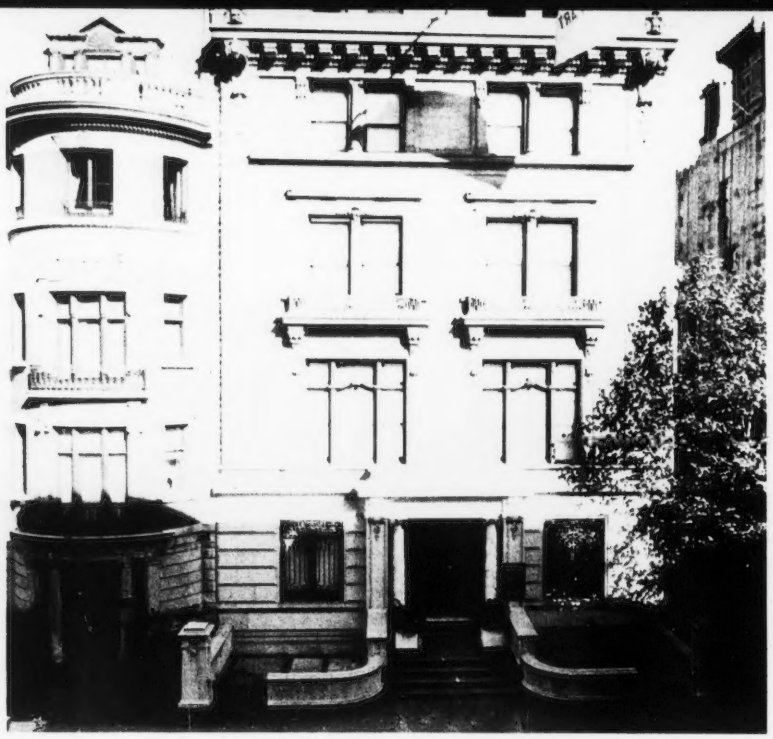
In 1871, The Metropolitan Museum of Art was temporarily housed at 681 Fifth Avenue (above left). In 1873 the collection was moved to The Douglas Mansion on West 14th Street (above right), and remained there until the first permanent building (page 75) was opened. Below is the main entrance today.



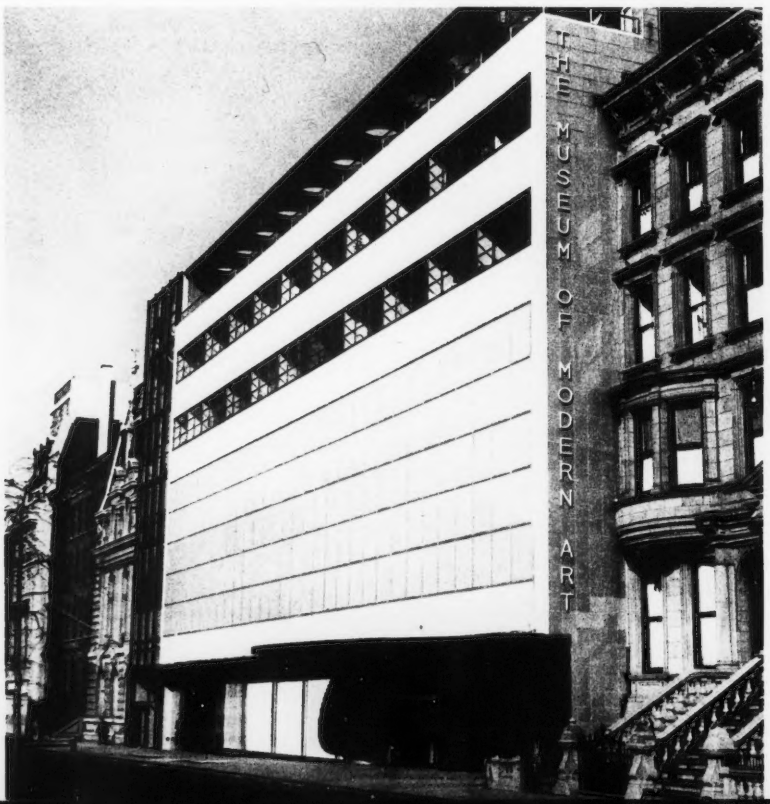


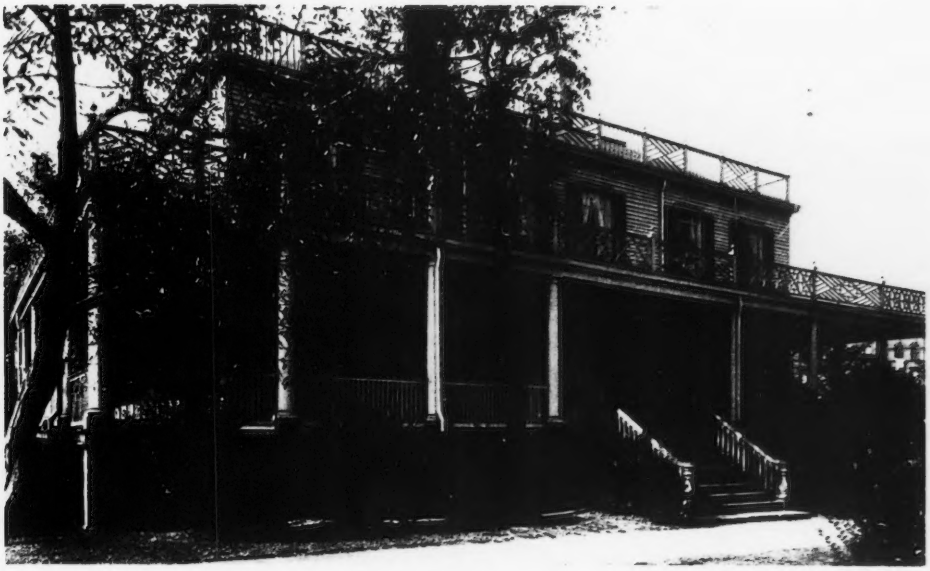


The Cloisters, uptown branch of The Metropolitan Museum (below), was not always the beautiful and elaborate reconstruction we know today. In 1925 (above), it was 698 Fort Washington Avenue, home of the late George Barnard, which, rearranged by the Museum, was opened to the public in 1926.

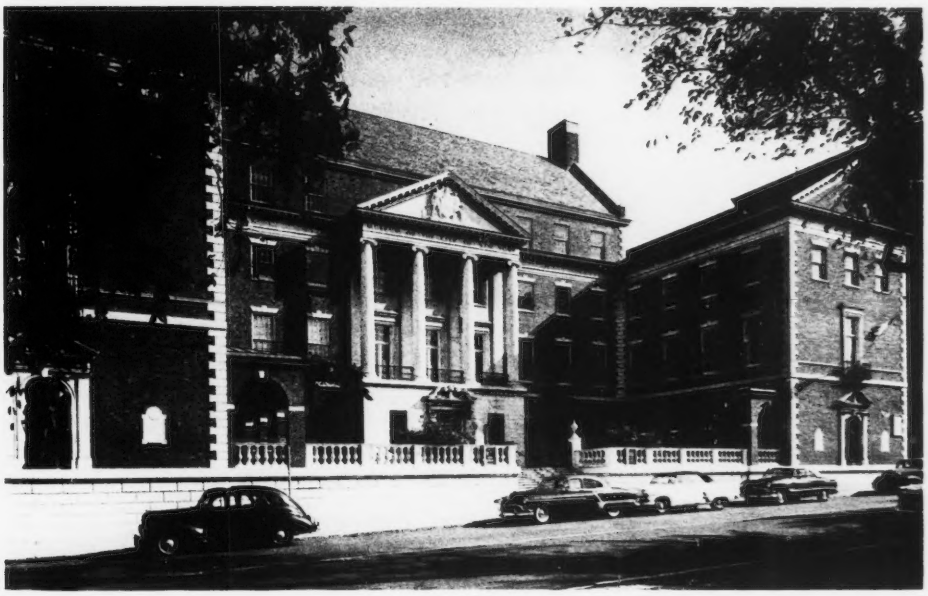


The first exhibit of The Museum of Modern Art was held in November 1929 in rented office space, and it was not until May 1932 that the permanent address became 11 West 53rd Street (above). Seven years later the present building was opened on the same site (below).





Surprisingly few people know that Gracie Mansion, late-18th century home of the Mayor of New York, housed the Museum of the City of New York upon its founding in 1923 (above). The present building (below), on Fifth Avenue and 103rd Street, was not opened until 1933.



One Hundred Curators: A Continuation

JOHN R. SAUNDERS, CHAIRMAN, DEPARTMENT OF PUBLIC INSTRUCTION
THE AMERICAN MUSEUM OF NATURAL HISTORY

Since the one hundredth curator was appointed in 1935 at The American Museum of Natural History, 58 additional curators (51 men, 7 women) have been appointed to the staff. The complete roster of curatorships from 1877 (date of first published curatorship) to 1957 comprises 158 individuals, 140 men and 18 women. Since 38 of these individuals are still active, the complete roster contains the names of 120 individuals whose curatorial careers have been terminated. These terminations were the result of a variety of causes. Some represent retirements, some deaths while in active service. Others represent resignations, and quite a few occurred when the curatorial classifications were removed from certain departments or when departments were eliminated. Some individuals who once held curatorships are still in active employ but do not now have the curatorial title.

Additional data has been secured from various directories such as "Who's Who" and "American Men of Science." This data has been organized to give information relative to the place of birth and the education (beyond secondary school) of the 158 individuals.

By comparing the data concerning the first 100 curators with the complete roster of 158 individuals, I attempted to discover any significant changes which might be construed as trends in length of service and distribution of curatorial effort. Finally, as an indication of the calibre of the early curators, some information regarding the evaluation of certain of these individuals by their co-scientists is given.

For the sake of historical record, a list of the 58 men and women who were appointed to curatorships from 1936 to 1957 is here presented.

Curators Appointed After 1935

NAME	CAREER SPAN	TOTAL CURATORIAL YEARS	AREAS OF SERVICE
Pough, F. H.	1936–1951	16	geology
Conrad, G. M.	1936–1942	7	comparative anatomy
Saunders, J. R.	1936–1951	16	public instruction
Blackwelder, R. E.	1936–1939	2	zoology
Bogert, C. M.**	1938–present	20	zoology
Beach, F. A.	1938–1946	9	experimental biology (animal behavior)
Pinkley, G.	1938–1943	6	comparative anatomy
Russell, C.	1938–1951	14	public instruction
Vokes, H. E.	1938–1942	5	geology
Bird, J. B.**	1939–present	19	anthropology
Coles, R. R.	1941–1950	10	astronomy
Ellis, B.**	1941–present	17	micropaleontology
Messina, A.*, **	1941–present	17	micropaleontology
Cazier, M. A.**	1941–present	17	zoology
Gilliard, E. T.**	1941–present	17	zoology
Ekholm, G. F.**	1942–present	16	anthropology
Oliver, J. A.	1942–1947	6	zoology
Michener, C. D.	1942–1947	6	zoology
Armstrong, J. C.	1942–1952	11	zoology
Orth, J. C.	1942–1951	10	public instruction
Larsen, H.	1943–1945	3	anthropology
Childs, G. H.	1943–1944	2	zoology
Schneirla, T. C.**	1943–present	15	animal behavior
Aronson, L. R.**	1943–present	15	animal behavior

Curators Appointed—continued

NAME	CAREER SPAN	TOTAL CURATORIAL YEARS	AREAS OF SERVICE
Blair, A. P.	1943–1946	4	animal behavior
Amadon, D.°°	1944–present	14	zoology
Breder, C. M.°°	1944–present	14	zoology
Ackerknecht, E.	1945–1946	2	anthropology
Atwater, G.	1945–1950	6	astronomy
Mason, G. F.	1945–1951	7	public instruction
Ford, J. A.°°	1946–present	12	anthropology
Svenson, H. K.	1946–1952	7	forestry
Newell, N. D.°°	1946–present	12	geology
Haas, O. H.	1946–1954	9	geology
Schaeffer, B.°°	1946–present	12	geology
Burns, W. A.	1946–1951	6	public instruction
Doyle, W. G.	1946–1950	5	public instruction
Tschopik, H.	1947–1956	10	anthropology
Barry, C. E.°	1947–1952	5	astronomy
Ross, M. R.°	1947–1951	5	public instruction
Pough, R. H.	1948–1950	3	conservation
Rindge, F. H.°°	1950–present	8	zoology
Salmon, E. S.°, °°	1951–present	7	micropaleontology
Falkner, E.°	1951	1	public instruction
Garton, R. I.	1951	1	public instruction
Rasquin, P.°, °°	1952–present	6	zoology
Clarke, W. D.	1953–1954	2	zoology
Mason, B. H.°°	1953–present	5	geology
Brass, L. J.°°	1954–present	4	zoology
Zweifel, R. G.°°	1954–present	4	zoology
Squires, D. F.°°	1955–present	3	geology
Van Gelder, R. G.°°	1956–present	2	zoology
Vaurie, C.°°	1956–present	2	zoology
Emerson, W. K.°°	1956–present	2	zoology
Bliss, D. E.°, °°	1956–present	2	zoology
Walters, V.°°	1956–present	2	zoology
Carneiro, R. L.°°	1957–present	1	anthropology
Lanyon, W. E.°°	1957–present	1	zoology

°Women °°Career not completed

By compiling tables similar to Tables 2 and 3 published in *One Hundred Curators: A Quantitative Study,*[1] and then comparing these tables, some changes were found. For example, the average length of the curatorial careers for the first 100 curators was 17.16 years, while the average length of the curatorial careers for the entire 158 curators showed a decline to 13.78 years. In addition, the average length of career for the first 90 completed careers was 15.95 years, and that for the entire 120 complete careers was 13.60 years, another decrease. This might appear to be a significant change, but inasmuch as the data includes curatorships which terminated when four departments were dissolved and when four other departments gave up the curatorial titles, it was considered wise to analyze the length of careers in those departments which are still active and which still retain curatorial titles. When this was done, it became evident that there has been no significant change in the average length of completed careers. The average length of the first 90 completed curatorial careers in these departments was 13.00 years and that for the first 120 completed curatorial careers was 13.11 years. However, when all the careers in those still-active departments were studied, it was found that the average length of careers (completed and incompleted) among the first 100 curators was 15.45 years, while the length for those among the entire 158 curators showed a drop to 12.87.

The additional 58 curatorships represent a total of 462 years of curatorial service. This figure, added to the total of 1,716 years of service performed by the first 100 curators, gives a grand total of 2,178 years of curatorial service to date. A total of 196 years of service was performed by the 30 individuals of this group who have completed their careers. This figure, added to the 1,436 years of completed curatorial careers, gives a grand total of 1,632 years of service for the 120 individuals who have completed their curatorial careers to date.

The percentage of curatorial effort to date for the departments still using the curatorial title was 80.9 (zoology 39.9, geology 20.0, anthropology 16.5, animal behavior 2.6, and micropaleontology 1.9), while that for all other departments no longer using curatorial titles or no longer active was 19.1. This 19.1 per cent was distributed as follows: comparative anatomy 3.4, Asiatic exploration .9, woods and forestry .6, public instruction 8.9, astronomy 2.6, library and publications 1.7, public health .S. conservation .1, and preparation .1. It should be noted that the departments of micropaleontology (now active) and of conservation (inactive) were added since 1935, as they do not appear on Tables 2 or 3 in *One Hundred Curators: A Quantitative Study.*

[1] *Curator,* 1958, Vol. I, No. 2, pages 22 and 23.

A comparison of the added data with that shown in Table 3 in the first article dealing with progression in rank shows a modest increase proportionately in the number of individuals holding only one rank in their completed careers. There are no significant changes in the other categories for individuals who held combinations of rank.

It has been possible to secure data concerning the place of birth of 147 of the 158 individuals studied. For 11 individuals who happen to be included in the first 100 curators, birthplace data was not available. The table which follows gives the distribution of places of birth for 89 of the first 100 curators and for all of the next 58 curators.

Place of Birth	First 100 Curators	58 Curators	Total
UNITED STATES OF AMERICA			
Middle Atlantic States	29	25	54
North Central States	23	8	31
New England States	19	5	24
Mountain and Pacific States	4	7	11
South Atlantic States	3	1	4
South Central States	0	3	3
Totals—U.S.A.	78	49	127
FOREIGN COUNTRIES			
Canada	4	2	6
Germany	3	1	4
England	2	0	2
Austria	1	1	2
Denmark	1	1	2
New Zealand	0	1	1
Australia	0	1	1
Sweden	0	1	1
France	0	1	1
Totals—Foreign Countries	11	9	20
NO DATA	11	0	11

It is interesting to note that five states produced 50 per cent of the 147 curators (44.92 per cent of 89 of the first 100 curators and 56 per cent of the next 58 curators). New York produced 42 curators, Massachusetts 11, New Jersey 8, California 6, and Connecticut 6, for a total of 73 curators.

The 147 curators hailed from 32 states and 9 foreign countries. The 89

of the first 100 curators came from 25 states and 5 foreign countries.

One slight shift that was noticed was that Massachusetts, which accounted for 11 of the first 100 curators, only accounted for one from the next 58 curators, whereas California, which provided one of the first 100 curators, provided 5 of the next 58. New York continues to lead in the production of curators. Twenty per cent of the first 100 curators were New Yorkers and the same state provided 38 per cent of the next 58 curators. Thus The American Museum of Natural History seems to receive a sizable portion of its curators from its home state.

Sixteen of the first 100 curators were self-educated (beyond the secondary school) and 84 attended colleges and universities. Fifty different colleges and universities (41 in the U.S.A., 9 abroad) provided the education for these 84 curators. Eighty-one of these individuals received academic degrees. Twelve held bachelors degrees only, 13 went to masters degrees and 56 attained their doctorates.

Five (8.4 per cent) of the next 58 curators were self-educated and 53 (91.6 per cent) attended college. These 53 curators were educated at 44 different schools (37 in the U.S.A., 7 abroad). Academic degrees were received by 51 (88 per cent) of the 58 curators. Five (9.8 per cent) held bachelors degrees only, 7 (13.00 per cent) went on to masters degrees, and 39 (76.5 per cent) attained their doctorates.

When analyzing the entire group of 158 curators, we find that 21 (13.3 per cent) were self-educated and 137 (86.7 per cent) attended college. This group attended 76 different schools, 61 in the U.S.A. and 15 abroad. Academic degrees were received by 132 or 83.55 per cent of the 158 curators. Of this group of 132 curators 17 (12.89 per cent) held bachelors degrees only, 20 (15.17 per cent) went on to masters degrees, and 95 (71.94 per cent) received their doctorates.

It is apparent that the percentage (91.6) of college trained curators among the last 58 curators to be appointed is greater than that for the first 100 curators, which was 84 per cent. If practices in operation at the end of this study (1957) are continued, all curators will be college trained and all will have attained their doctorates.

The following list of colleges and universities attended by the 137 curators of the entire 158, indicates no particular danger of inbreeding as far as any single school is concerned. Since some curators attended more than one undergraduate school and some attended more than one graduate school a total of 212 instances of school attendance was found for the 137 individuals. The list which follows indicates the name of the school and the number of individuals who attended that school. The parenthesized figures show the number of the first 100 curators who attended the indicated schools, followed by the number of the next 58 curators who

attended. The schools are listed in the order of greatest attendance by the curators.

Colleges and Universities Attended

Columbia, 41 (26-15); Harvard, 16 (10-6); California, 14 (5-9); Cornell, 9 (3-6); University of Michigan, 9 (5-4); Yale, 8 (6-2); New York University, 7 (3-4); Brown, 6 (5-1); College of the City of New York, 5 (5-0); University of Chicago, 4 (3-1); University of Kansas, 4 (2-2); Berlin (Germany), 3 (3-0); Johns Hopkins, 3 (3-0); University of Indiana, 3 (2-1); Minnesota, 3 (1-2); Pennsylvania, 3 (1-2); Wellesley, 3 (2-1); Clark, 3 (3-0); Haverford, 2 (1-1); Hunter, 2 (0-2); Illinois, 2 (0-2); Massachusetts Institute of Technology, 2 (1-1); Montreal, 2 (2-0); University of Nebraska, 2 (2-0); Oberlin, 2 (0-2); University of Paris (France), 2 (1-1); Princeton, 2 (2-0); Washington (St. Louis), 2 (1-1); Baltimore City College, 1 (1-0); Barnard, 1 (1-0); Bates, 1 (1-0); Beloit, 1 (1-0); Cambridge (England), 1 (1-0); Colby, 1 (1-0); Colorado A. & M., 1 (0-1); Copenhagen (Denmark), 1 (0-1); Earlham, 1 (1-0); Eureka, 1 (1-0); Heidelberg (Germany), 1 (1-0); Hobart, 1 (0-1); Iowa, 1 (1-0); Iowa State, 1 (1-0); Kansas State, 1 (1-0); Kansas State Teachers College, 1 (0-1); Kiel (Germany), 1 (1-0); Leipzig (Germany), 1 (0-1); Louisiana State, 1 (0-1); Manhattan, 1 (0-1); Marietta, 1 (0-1); McGill, 1 (0-1); Miami (Ohio), 1 (1-0); Mt. Holyoke, 1 (0-1); Nashville, 1 (1-0); New Brunswick, 1 (1-0); Occidental, 1 (0-1); Oehringen (Germany), 1 (1-0); Oklahoma, 1 (1-0); Pembroke, 1 (0-1); Purdue, 1 (0-1); Radcliffe, 1 (0-1); Rutgers, 1 (0-1); San Diego State College, 1 (0-1); Smith, 1 (0-1); Sorbonne (France), 1 (0-1); Southern California, 1 (0-1); Stanford, 1 (1-0); Stockholm (Sweden), 1 (0-1); Toronto (Canada), 1 (1-0); Tulsa, 1 (0-1); United States Naval Academy, 1 (1-0); University of Utah, 1 (1-0); Vienna (Austria), 1 (0-1); Virginia, 1 (1-0); Washington (Seattle), 1 (1-0); Williams, 1 (1-0); University of Wisconsin, 1 (0-1).

For some years (1903–1943) "American Men of Science" starred outstanding scientists, and in the first edition (1903) used a number system to indicate rank or order of distinction in the several scientific disciplines. Both the starring and ranking were based upon ratings provided by the scientists' colleagues in the various fields of science.

Thirty-two of the first 100 curators were starred as outstanding men in their field. Three of the 32 starred curators were starred in more than one science, one in 3 fields (anatomy, geology and zoology), two in 2 fields (geology and zoology). The distribution of the 29 other starred curators was as follows: 13 in zoology, 11 in anthropology, 4 in geology, and 1 in anatomy.

Twelve of these curators were ranked in the order of their distinction in the various fields of science. One individual was ranked in 3 different fields, and one in 2 fields. The distribution of the 15 rankings was as follows: anthropology—#1, #5 (out of 20 starred in field); anatomy—#5 (out of 25 starred in field); zoology—#5, #9, #17, #26, #33, #44, #51, #65, #114, #138 (out of 150 starred in field); geology—#19, #35 (out of 100 starred in field).

It is hoped that perhaps similar studies can be made of curatorial careers in other parts of the United States. From an aggregate of such studies could emerge a more complete picture of the professional character of the museum group known as curators.

NEW MATERIALS AND TECHNIQUES

Color Harmony Manual, *Egbert Jacobson, Walter C. Granville, Carl E. Foss. Copyright, Container Corporation of America, 1948. $150.00, less 10% discount for educational institutions.*

This handsome kit puts a scientific color theory (Ostwald) into a form to serve as a working aid in solving practical problems involving uses of color.

The range of full-strength colors is encompassed by a circle of thirty hues. Each hue is represented here on a separate chart of twenty-eight chips, which embrace modulation of the color toward white and black. These loose-leaf charts are arranged in two groups side by side in the portfolio, so that two colors can be viewed at once. The total range of color is represented by 943 chips. These chips are one-inch plastic hexagons, glossy on one side and matte on the other, with a tab for easy insertion into slotted work cards which are provided, making for easy trial and experiment with color relations in various combinations.

This system provides a precise method of color designation—each hue has a number, each gradation a combination of letters, and the information is printed on each chip. Thus, when a color or colors are selected for a job of painting, printing, or other application, the chips can be used for the jobber to match. Two commercial firms, the Martin-Senour Company, manufacturer of bulk paint, and Shiva, manufacturer of artists' tube paint, have collaborated with the producer of this manual to put on the market lines of paints keyed to this manual. In this way, colors can be ordered by number designation, with the obvious advantages of

clarifying and simplifying the work.

A concise booklet accompanying the set outlines the various principles of color harmony. These are extremely easy to grasp, and provide convenient approaches to experimentation with color relationships.

The value of this manual is twofold. First, its systematic organization of color in full range keeps one constantly aware of the location of a particular color in relation to all others. Second, the convenience of the make-up enables the user to manipulate color easily by removing chips from their places in the scheme, and trying them with others. In this way, one proceeds always within an orderly system, either logically in finding specific colors or spontaneously if looking at random for color ideas. It is the only product I know on the market that provides these advantages, which are vital to any work involving uses of color, whether in selecting a scheme for an interior, in identifying a given color, in preparing printed matter, or in the design of an exhibition.

HENRY GARDINER, Exhibit Designer
Exhibition Department

Plastisol is the miracle medium every museum's exhibition department should know about. It can be molded, modeled, drilled, cut, sanded, patched, painted, or stained. When kneaded, it has the consistency of bread dough. A little oil color from a tube can be mixed with the Plastisol to obtain a basic tone, or tint, before baking.

After the model or sculpture piece is finished, place it in an oven at 150° or 175° F. for approximately one hour, so that the Plastisol is of a semi-rubberish consistency. Higher temperatures will make it harder and brittle. Best results can be obtained through experimentation.

After baking, and when the model is thoroughly cooled, it may be painted; tempera, oil, or lacquer can be applied directly over the Plastisol surface without previous priming or shellacking.

Plastisol (Vinyl Dough 78x189—include code number) can be purchased from:

The Sculpture House
304 West 42nd Street
New York 36, New York

Minimum order is ten pounds at approximately ten dollars.

(Additional contributions on new materials and techniques would be appreciated.)

L. P. W.

CURATOR BOOK REVIEWS

Atlas De Los Colores *(Colour Atlas). C. Villalobos–Dominguez and Julio Villalobos. English text by Aubrey Malyn Homer. Containing 7279 colours, with designations, on 38 plates with explanatory text. Libreria El Ateneo Editorial, Buenos Aires, Argentina, 1947, $25*

The Villalobos "Colour Atlas" is probably one of the finest color recording systems yet developed. It should prove to be the most valuable tool for the museum exhibition specialist.

The Atlas contains 7,279 colors, including twenty-one values of the gray scale. The classification of colors is based on the pure simple spectrum of white light. The nomenclature is based on the three fundamental colors of the spectrum, as all others are the result of mixtures of radiations of those fundamentals. The colors contained in the Atlas are all different, and are graduated in such a way that the difference between those contiguous is the least that may be required in practice, and as constant as possible. The number of colors contained in the Atlas ensures that, in general, a match can be found for the color of any object.

Each color square printed on the page has a small hole punched through it so that close comparisons can be made. Each color is also keyed by letters and numbers, so that easy notation is possible.

The English text which accompanies the Atlas explains in detail the best methods by which the Atlas can be used. The major chapter headings include the following:

I. Comparison Of Colors
II. The System Of Classification And Notation
III. To Determine and Symbolize Any Given Color

IV. To Identify Colors In The Absence Of The Atlas
V. Color Matching
VI. Two Simple Methods of Color Harmony

L. P. W.

A History of Technology, *Volume III, From The Renaissance To The Industrial Revolution c. 1500 to c. 1750. Charles Singer, E. J. Holmyard, and A. R. Hall, Trevor I. Williams. London, Oxford University Press, 1957, 798 pp., illus., $26.90*[1]

Volume I, "From Early Times To Fall Of Ancient Empires" and Volume II, "The Mediterranean Civilizations And The Middle Ages," depended principally on expert scientific and technical research on objects dating from earliest times to the classical civilizations and the cultures that arose in barbarian Europe. Volume III is able to draw on contemporary printed sources, since the invention of the printing press made it possible to set down in detail and with copious illustrations the growing wealth of technical data.

The foundation for a scientific technology that would shape the future course of civilization was laid in the belief that a knowledge of nature confers power to control its forces. Great findings were made in pure science, and Bacon, Galileo, and Déscartes added the brilliance of their names to the new light that was dawning on the world.

These intellectual and technical forces were gathered together in western Europe, effecting a change in the relationship of this part of the world to the Near East, the source from which came western developments in science and technology. Europe was now the first user of raw materials and the prime exporter of manufactured goods. Where the ships of Phoenicia, Greece, and Rome once dropped their anchors, the merchantmen of Europe unloaded their cargoes. The mathematicians and scientists of the Near East gave way to the experimentation and philosophy of the scholars of European universities. The world was again on the move to the West, both in science and in technology.

The dominance of the West has continued to this day, swinging slowly to its position of power before the close of the Middle Ages. The curve of technological history turns sharply upward, feeding upon its own constituents—pure science, an increase in technical knowledge, new machines, an abundant supply of natural resources and materials, the spread of knowledge by means of the printed word, and an increasing world market that stimulated production and more efficient and cheaper methods of manufacture.

The third volume of "A History of Technology" covers five principal fields: primary production, manufacture, material civilization, communications, and the approach to science.

Part I—primary production—includes food and drink, describing the effect of new foodstuffs; changing agricultural techniques; improvements in milling methods; progress in preparing, preserving, and testing food; and changing views on diet and the rise of dietetics as a science. The potato, maize, tea, coffee,

[1] See *Curator*, Vol. I, No. 1, page 95, for reviews of "A History of Technology," Vol. I and Vol. II.

chocolate, cocoa, and other new products became family staples, and new methods of food preservation permitted a world-wide distribution of edibles once restricted to almost immediate consumption. Metallurgy, assaying, coal mining and utilization, and a study of windmills sum up Part I.

Part II—manufacture—deals with tradesmen's tools, vehicles, harness, spinning and weaving, figured fabrics, and glass.

Part III—material civilization—includes building construction, town planning from the ancient world to the Renaissance, land drainage and reclamation, machines and mechanisms, military technology, and printing.

Part IV—communication—treats of canals and river navigation, the development of bridges, cartography, survey, and navigation.

Part V sums up Volume III with a history of the improvement of ancient calendars, precision instruments to 1500, the manufacture of scientific instruments from c. 1500 to c. 1700, a fascinating article on mechanical timekeepers, and invention in chemical industries.

Volume III, "From The Renaissance To The Industrial Revolution," is written in the same understandable style as were the first two volumes of "A History of Technology." There are few technical or scientific terms that will not be understood by the layman. The illustrations are wonderfully clear and profusely scattered throughout the book. The cost of Volume III has increased slightly from the price of Volumes I and II but, regardless of its cost, no museum can afford to be without this monumental work.

The authors stress the dominance of the West in science and in technological development without pointing out, at the same time, the fact that *Homo sapiens* has the ability to acquire scientific knowledge and technical skills, regardless of origin. This may be a social or political point which the authors may not have attempted to encompass thus far or may feel to be outside the province of a history of technology, but it is one that we cannot afford to ignore.

The West was once not dominant, is now dominant, and will remain so just as long as its political philosophy, its intellectual life, its safeguarding of its own institutions, and its concern about the fate of the rest of the world remain on a high level.

The Australian bushman can be taught to read and write and run a power lathe. The Dyak and the Hottentot can push a button or pull a trigger. And the great masses of people, now on the dark fringes of an otherwise bright world civilization, can, by embracing the science and the technology of the West, lift themselves to our level and overwhelm us by sheer weight of numbers.

W. A. B.